



*This book is presented  
by  
The Government of the United States  
as an expression of  
Friendship and Goodwill  
of the  
People of the United States  
towards  
The People of India*

132

no: 21813

221  $\frac{9}{5}$

**DATE LABEL**


Call No.....

Date.....

Account No.....

**J. & K. UNIVERSITY LIBRARY**

This book should be returned on or before the last stamped above.  
An overdue charges of 6 nP. will be levied for each day. The book is kept beyond that day.





*Geological Society of America*  
*Memoir 11*

---

MOLLUSCA OF THE  
TERTIARY FORMATIONS  
OF NORTHEASTERN MEXICO

BY  
JULIA GARDNER  
U. S. National Museum, Washington, D. C.



---

December 15, 1945

By

Made in United States of America

527-78  
G 174 M

By

8/282



ALLAMA IQBAL LIBRARY



21813

HT 01

R61



*The Memoir Series  
of  
The Geological Society of America  
is made possible  
through the bequest of  
Richard Alexander Fullerton Penrose, Jr.*





### ACKNOWLEDGMENTS

The list of those who have in some manner shared the work and the problems of this report has been growing through many years. A cheerful patience is, perhaps, the difficult virtue exacted in largest measure from my friends, and I trust they still retain some interest in the results of the investigations which they have made possible. The generous funds were granted from the Penrose Bequest of The Geological Society of America.

The extensive collections of Tertiary Mollusca upon which the study is based were submitted by the Mercedes, the Huasteca, and the Transcontinental Petroleum companies operating in Mexico. During most of the time, the companies were represented by William A. Baker, Jr. For his whole-hearted co-operation and that of the field men, Harold Haight, Stanley Say, and John Regan, I am in lasting debt.

I am grateful to Lloyd W. Stephenson for his helpful encouragement during the early part of the work; to Edgar Bowles for his ready and willing aid in the laboratory; to Harry S. Ladd, who photographed the specimens; to the innocent bystanders, Ralph Stewart and Harald Rehder, who cheerfully joined in importunate discussions of identification and nomenclature; and, at the last, to John B. Reeside, Jr., who has done so carefully and so justly the dreariest task of all, that of reading the manuscript.





# CONTENTS

	Page
ABSTRACT.....	1
HISTORICAL BACKGROUND.....	1
STRATIGRAPHIC NOTES.....	4
General statement.....	4
Paleocene series.....	4
Midway formation.....	4
Discussion.....	4
Lower part of Midway formation.....	4
Upper part of Midway formation.....	7
Eocene series.....	7
Wilcox group.....	7
Indio formation.....	7
Claiborne group.....	9
Discussion.....	9
Carrizo sand.....	9
Mount Selman formation.....	10
Laredo formation.....	11
Yegua formation.....	14
Jackson formation.....	16
Discussion.....	16
Roma sandstone.....	16
Jackson formation (undifferentiated).....	16
Oligocene series.....	17
General statement.....	17
Lower and Middle Oligocene.....	17
Lower marine sandstone.....	17
Nonmarine bed.....	18
Upper marine sandstone.....	18
Upper Oligocene.....	19
Miocene series.....	19
Lower Miocene.....	19
Guajalote formation.....	19
Middle Miocene.....	21
Oakville sandstone.....	21
U. S. GEOLOGICAL SURVEY STATION NUMBERS.....	21
SYSTEMATIC DESCRIPTIONS.....	40
Phylum Vermes.....	40
Class Chaetopoda.....	40
Phylum Mollusca.....	40
Class Pelecypoda.....	40
Order Prionodesmacea.....	40
Superfamily Nuculacea.....	40
Family Nuculidae.....	40
Family Nuculanidae.....	43
Superfamily Arcacea.....	50
Family Glycymeridae.....	50
Family Arcidae.....	51
Superfamily Mytilacea.....	56
Family Mytilidae.....	56
Superfamily Pteriacea.....	58



	Page
Family Pteriidae.....	58
Family Pinnidae.....	60
Superfamily Pectinacea.....	61
Family Pectinidae.....	61
Family Spondylidae.....	70
Superfamily Anomiacea.....	71
Family Anomiidae.....	71
Superfamily Ostreacea.....	75
Family Ostreidae.....	75
Order Anomalodesmacea.....	85
Superfamily Anatinacea.....	85
Family Pholadomyidae.....	85
Family Thraciidae.....	86
Superfamily Poromyacea.....	88
Family Cuspidariidae.....	88
Order Teleodesmacea.....	89
Superfamily Astartacea.....	89
Family Astartidae.....	89
Family Crassatellitidae.....	90
Superfamily Carditacea.....	92
Family Carditidae.....	92
Superfamily Lucinacea.....	94
Family Lucinidae.....	94
Family Diplodontidae.....	97
Superfamily Leptonacea.....	98
Family Kelliellidae.....	98
Superfamily Cardiacea.....	99
Family Cardiidae.....	99
Superfamily Tellinacea.....	105
Family Tellinidae.....	105
Family Garidae.....	108
Family Donacidae.....	110
Superfamily Solenacea.....	110
Family Solenidae.....	110
Superfamily Mactracea.....	112
Family Mactridae.....	112
Subfamily Mactrinae.....	112
Subfamily Pteropsinae.....	112
Family Mesodesmatidae.....	113
Superfamily Veneracea.....	114
Family Veneridae.....	114
Superfamily Myacea.....	126
Family Corbulidae.....	126
Family Saxicavidae.....	138
Superfamily Adesmacea.....	138
Family Pholadidae.....	138
Family Teredinidae.....	139
Class Scaphopoda.....	141
Family Dentaliidae.....	141
Family Siphonodentaliidae.....	142
Class Gastropoda.....	144
Subclass Streptoneura.....	144
Order Aspidobranchia.....	144



	Page
Superfamily Trochacea .....	144
Family Skeneidae .....	144
Superfamily Neritacea .....	144
Family Neritidae .....	144
Order Pectinibranchiata .....	145
Suborder Gymnoglossa .....	145
Family Pyramidellidae .....	145
Suborder Ptenoglossa .....	146
Family Epitoniidae .....	146
Family Epitoniidae? .....	149
Family Architectonicidae .....	150
Suborder Taenioglossa .....	153
Superfamily Cerithiacea .....	153
Family Turritellidae .....	153
Family Vermetidae .....	154
Family Melaniidae .....	154
Family Cerithiidae .....	156
Family Litiopidae .....	162
Superfamily Calyptraeacea .....	163
Family Calyptraeidae .....	163
Superfamily Strombacea .....	163
Family Xenophoridae .....	163
Family Aporrhaidae .....	164
Family Strombidae .....	164
Superfamily Naticacea .....	169
Family Naticidae .....	169
Family Sinidae .....	177
Superfamily Cypraeacea .....	178
Family Cypraeidae .....	178
Superfamily Doliacea .....	179
Family Cassididae .....	179
Family Ficidae .....	182
Family Cymatiidae .....	184
Suborder Stenoglossa .....	187
Superfamily Muricacea .....	187
Family Muricidae .....	187
Superfamily Buccinacea .....	189
Family Pyrenidae .....	189
Family Nassariidae .....	190
Family Buccinidae? .....	194
Family Buccinidae .....	194
Family Busyconidae .....	205
Family Fusinidae .....	206
Family Xancidae .....	210
Family Fasciolaridae .....	211
Superfamily Volutacea .....	216
Family Olividae .....	216
Family Mitridae .....	220
Family Volutidae .....	222
Superfamily? Toxoglossa .....	229
Family Cancellariidae .....	229
Family Turridae .....	230
Family Conidae .....	250
Family Terebridae .....	255

	Page
Subclass Euthyneura .....	258
Order Opisthobranchia .....	258
Suborder Tectibranchia .....	258
Family Acteonidae .....	258
Family Ringiculidae .....	260
Family Acteocinidae .....	260
Family Atyidae .....	262
Family Scaphandridae .....	262
Order Pteropoda .....	266
Suborder Thecosomata .....	266
Family Cavoliniidae .....	266
Subclass Pulmonata .....	266
Superfamily Bulimulacea .....	266
Family Urocoptidae .....	266
Superfamily Helicacea .....	267
Class Cephalopoda .....	268
Order Nautiloidea .....	268
Family Clydonautilidae .....	268
Phylum Arthropoda .....	269
Subphylum Insecta .....	269
Order Hymenoptera .....	269
EXPLANATION OF PLATES .....	273
INDEX .....	301



## ILLUSTRATIONS

### PLATES

Plate	Facing page
1. Tertiary Mollusca.....	274
2. Tertiary Mollusca.....	275
3. Tertiary Mollusca.....	276
4. Tertiary Mollusca.....	277
5. Tertiary Mollusca.....	278
6. Tertiary Mollusca.....	279
7. Tertiary Mollusca.....	280
8. Tertiary Mollusca.....	281
9. Tertiary Mollusca.....	282
10. Tertiary Mollusca.....	283
11. Tertiary Mollusca.....	284
12. Tertiary Mollusca.....	285
13. Tertiary Mollusca.....	286
14. Tertiary Mollusca.....	287
15. Tertiary Mollusca.....	288
16. Tertiary Mollusca.....	289
17. Tertiary Mollusca.....	290
18. Tertiary Mollusca.....	291
19. Tertiary Mollusca.....	292
20. Tertiary Mollusca.....	293
21. Tertiary Mollusca.....	294
22. Tertiary Mollusca.....	295
23. Tertiary Mollusca.....	296
24. Tertiary Mollusca.....	297
25. Tertiary Mollusca.....	298
26. Tertiary Mollusca.....	299
27. Tertiary Mollusca.....	300
28. Map of northeastern Mexico showing fossil localities.....	Back cover

### FIGURE

Figure	Page
1. Key map .....	2

### TABLES

Table	Page
1. Tentative correlation of deposits in northeastern Mexico with those in other parts of the Gulf Province.....	5
2. Distribution of the Mollusca in the lower Eocene.....	34
3. Distribution of species mostly Mollusca in the Claiborne group.....	36
4. Distribution of the Mollusca in the Jackson formation.....	37
5. Distribution of the Mollusca in the Oligocene.....	38
6. Distribution of the Mollusca in the Miocene.....	39







## ABSTRACT

The molluscan faunas north of the Rio Grande and those of the Tampico Embayment have been fairly well known for many years. The intermediate faunas between the Rio Grande and the Rio Conchos were untouched until the interest in petroleum investigations was focused on northeastern Mexico. The report is a systematic study of molluscan collections made in the course of the geological field work. Old species are discussed, and new species from the Eocene, Oligocene, and Miocene series are described and figured.

An attempt is made to relate them to the faunas of known areas. A few introductory paragraphs have been written on the historical development of the area and on the stratigraphic background.

## HISTORICAL BACKGROUND

Until comparatively recently the coastal plain of northeastern Mexico has received little attention from geologists. The arid, forbidding terrane exhibits scant evidence of a great past in either its human or its natural monuments. Mexico is proverbially the land of strong contrasts, and the northeastern coastal plain seems little more than the dusty flank of one of the most imposing of the Cordilleran sections.

The literature is scant, and much of it is incidental information in articles concerned with other areas and aspects. The appended bibliography is by no means complete. An effort has been made to include those papers dealing primarily with the area under discussion and those which contribute to the interpretation of the geology of northeastern Mexico. The Mexican Boundary reports of the 1850's do not penetrate beyond Mier and the Rio Salado.

All that was known of Tamaulipas in the middle of the nineteenth century is included in the *Historia, geografía y estadística del Estado de Tamaulipas* by the civil engineer, Alejandro Prieto, published in Mexico in 1873. The map, attested to be an exact copy of an original in the Archivo General, dates from the time of the organized settlement of northern and central Tamaulipas in the late 1740's and early 1750's. It bears the title of the *Mapa de la Sierra gorda, y costa de el Seno Mexicano, desde la Ciudad de Queretaro, situada, cerca de los 21 g<sup>s</sup> hasta los 28½ en que está, la Bahia de el Espiritu Santo, sus Rios, Ensenadas, y Provincias, que circumbalan la Costa del Seno Mexicano, reconocida, Pacificada, y Poblada en la Mayor parte, por Don Joseph de Escandon*. The scale was 10 leagues to 1⅞ inches. It covered the Colonia del Nuevo Santander, the name by which Tamaulipas was known during the Spanish occupation, but the entire area between the Rio Conchos and the Rio del Norte and beyond that to La Bahia del Espiritu Santo and westward from the Seno Mexicano to Reynosa is a blank except for an occasional Indian in feather hat and belt.

The book is in the main historical, but the history is closely correlated with the geography and resources of the country.

Nuevo Santander during the occupation extended to the Nueces. After the Independence in 1820, the name was changed to Tamaulipas (Montes Altos), and the northern boundary, by the treaty of Guadalupe, 1848, was fixed at the Rio Grande. There is no record of the exploitation of any natural resources other than salt by the natives of the northeast Mexican coastal plain. In southern Tamaulipas,



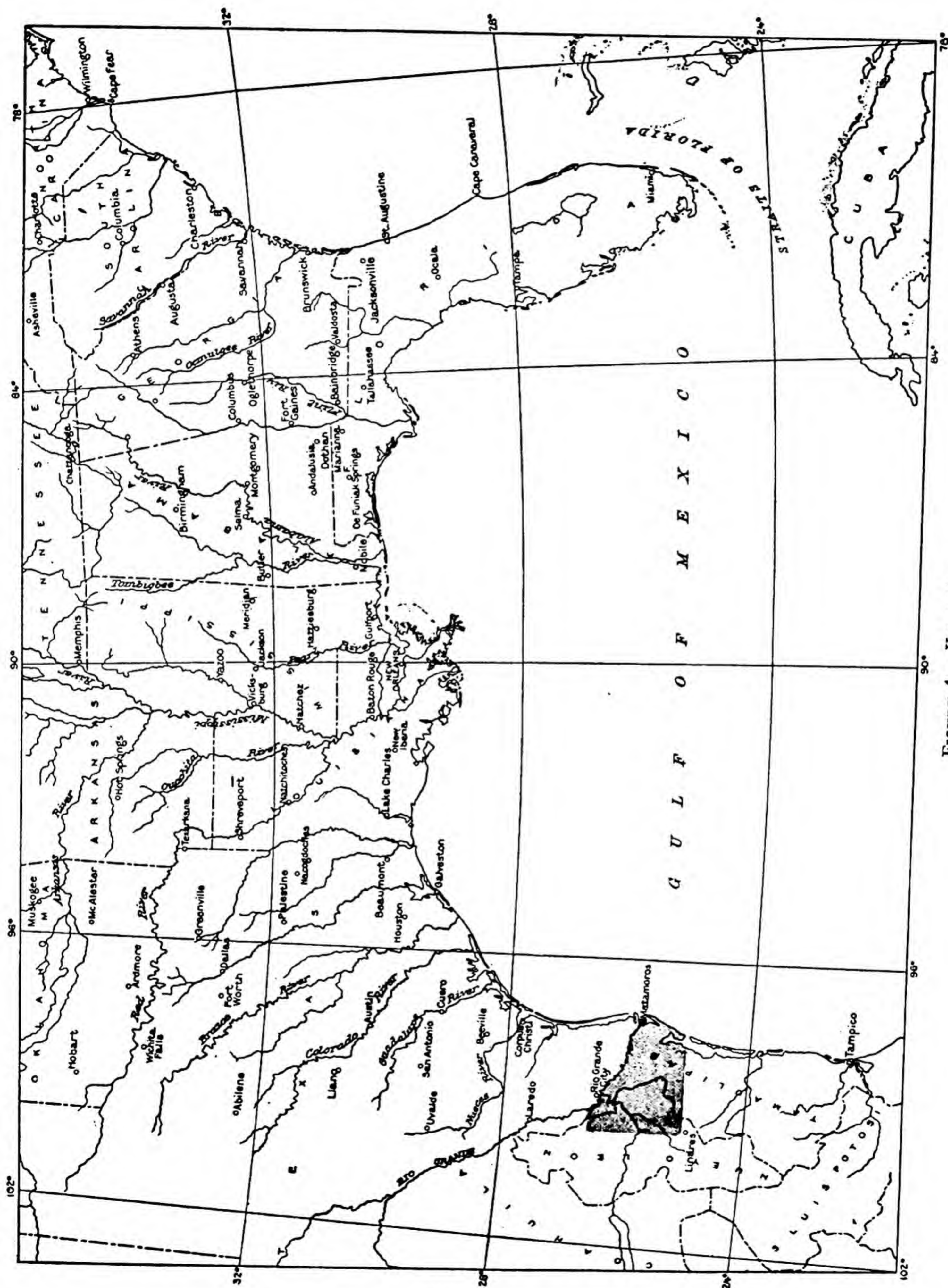


FIGURE 1.—Key map



chapapote was reported in a number of localities. Local use was made of it, but there was no attempt to develop it or to find a market for it. The author, himself an engineer, realized something of its potentialities and saw no reason why, with proper development, Tamaulipas should not equal or exceed in production Oil City, "la capital del país del aceite en el Estado de Pensilvania."

Very little is recorded from northeastern Mexico during the last quarter of the nineteenth century. The physiography of the Coastal Plain was an incidental topic in two papers by Hill in the early 1890's.

In 1906, the International Geological Congress met in Mexico City. The mining districts and the igneous, metamorphic, and older sedimentary rocks were the centers of interest. One of the earlier geological guides covered San Luis Potosí, Nuevo León, and Tamaulipas, but reconnaissance observations in the Coastal Plain were sketched in broad, crude lines. An observation on the road from Mier to Camargo reads "Hasta el rancho de las Guerras está descubierta la arenisca y formación fosilífera."

Dumble's were the first reports on northeastern Mexico with more than a historical interest. He, assisted by R. A. F. Penrose, did the first field work primarily concerned with the Tertiary coastal plain of that area. His reports cover a period of 10 years or more, the years which include the First World War, the frenzied development of all natural resources, the Tampico oil boom, and, coincident with these, the organization of the microfaunal investigations. Dumble recognized the value of organic remains and used them as a basis for correlation with the Tertiary deposits of Texas and of the eastern Gulf region. The Cretaceous-Eocene contact drawn on the later maps is essentially that first traced by Dumble, which speaks both for the sharpness of the contact and the keenness of the observer. Dumble's interpretation involved a strong north-south component in the strike of the Tertiary formations and an overlapping to the east and south, for in the vicinity of Tordo Bay the Miocene San Fernando formation rests directly on the Cretaceous Papagallos shale. Only the detail of the picture has been altered by later investigations, and Dumble's reconnaissance was a spring-board for all the later work in the Rio Grande Embayment. The Tertiary of northeastern Mexico has been on the fringe of areas and formations covered by a number of careful studies, such as that of T. Wayland Vaughan, 1918, on Central America and the West Indies; of L. W. Stephenson, 1928, on the *Structural features of the Atlantic and Gulf Coastal Plain*; of John M. Muir, 1936, on the *Geology of the Tampico Region*; and of Lewis B. Kellum, 1937, on the *Geology of the San Carlos Mountains*. Other valuable structural and stratigraphic papers include those by Trowbridge (1923), Tatum (1935), and especially those by Kane (1936) and Kane and Gierhart (1935). Tatum described at some length certain areas in northeast Mexico. It is impossible to pass over an error that recurs several times in his otherwise excellent papers. The Carrizo sand and the Bigford formations of the Trowbridge reconnaissance report were placed in the Wilcox group, not because of any misconception of their field relations, but for no other reason than the paleobotanical evidence. The paleobotanists were unyielding and unequivocal in their determinations, and in the absence of other organic remains and unmistakable field evidence the floral evidence was accepted. The errors in



Tatum's first paper were, however, largely corrected in his second. Schuchert (1935) gave a broad picture of the past diastrophism and the general tectonic relationships of Mexico to the rest of mid-America. Sellards' and Baker's *Structural geology of Texas* (1934) is of pertinent value in northeast Mexico, for, geologically speaking, the boundaries of Tamaulipas still extend to the Nueces as they did politically before the treaty of Guadalupe.

## STRATIGRAPHIC NOTES

### GENERAL STATEMENT

The stratigraphic notes, uneven in degree of detail and of treatment, have been assembled from various sources and are presented in the hope of providing some background for the mass of systematic detail. The notes are inadequate, and many of the interpretations are not established, but the men who did the field work were not in a position to write the report.

Table 1 implies an exactness of knowledge that far exceeds our incomplete and scattered information.

### PALEOCENE SERIES

#### MIDWAY FORMATION

*Discussion.*—The Midway formation of northeastern Mexico is potentially a group, divisible into formations and the formations into members. The lithology is broadly similar to that of the Midway group of Texas, but the thickness may be measured in thousands rather than hundreds of feet. The excess thickness of the Midway in Mexico is in the shale and clay beds. The sandy limestone, characteristic of the upper Kincaid formation of Texas, is relatively unimportant in northeastern Mexico. Although certain localities such as the scarp near Agualeguas may safely be referred to the Kincaid, both on lithologic and faunal characters, the limits of the Kincaid cannot be drawn in this report, and the group treatment seems better suited to the information available.

*Lower part of Midway formation.*—On the Texas side of the Rio Grande, fossiliferous Midway beds of the Kincaid formation immediately succeed the Cretaceous, but in the Cerralvo area, about 100 miles due south of Laredo and 85 miles west-southwest from Mier, the Cretaceous is overlain by several hundred feet of unfossiliferous dark greenish-gray shaly clays that weather reddish.

Two concretionary zones have been recognized in the clays. In the lower part of the series, among the most common types of concretions are dark-gray spheroidal geodes, 2.5 to 3 inches in diameter, with dense, banded outer walls, and interiors partially filled with calcite crystals increasing in size toward the center. Turtle backs of dense-gray claystone reticulated on the outer surface by raised calcite seams are also common. Concretions are widely distributed throughout the greater part of the Midway section in Texas, but they differ from these Mexican types. In the upper zone in Mexico, claystone cylinders are common; the dark neutral-gray surface is deeply scored, possibly by the solution of former calcite seams; the brown color of the remaining calcite may be due to an admixture of pyrite; the partially filled interior is usually oxidized to a dark red. Rounded concretions about the



size of baseballs, and others larger at one end and irregular in outline are also common. The concretions from the lower zone in the Cerralvo area are generally larger than those from the upper zone, but some of the claystone cylinders in the upper zone exceed 3 inches in diameter.

TABLE 1.—Tentative correlation of deposits in Northeastern Mexico with those in other parts of the Gulf Province

	Generalized section	Northeastern Mexico	South Texas	Alabama	Florida
MIOCENE	Upper incomplete				Duplin marl
	Middle	Oakville sandstone	Oakville sandstone	Undifferentiated	Alum Bluff group { Shoal River formation Oak Grove sand member Chipola formation
	Lower	Guajalote formation ? ? ? ?	Catahoula tuff	Catahoula sandstone	Tampa limestone
OLIGOCENE	Upper	Upper limestone		Chickasawhay limestone	Suwannee limestone
	Middle	Upper marine sandstone Nonmarine clay Lower marine sandstone	Frio clay ? ? ? ? ?	Vicksburg group	Byram limestone
	Lower	? ? ? ?		Red Bluff clay	Marianna limestone
EOCENE	Jackson	Upper	Whitsett	Yazoo clay	Ocala limestone
		Middle	McElroy	Cocog sand member	
		Lower	Caddell	Moody's Branch marl	
	Jackson formation { Roma sand member		Jackson formation { Roma sand member		
	Claiborne	Yegua formation	Yegua formation		Covered
		Laredo formation { Upper Middle Lower	Laredo formation { Cook Mountain formation	Lisbon formation	
		Mt Selman formation	Mt Selman formation		
PALEOCENE	Midway	Carrizo sand	Carrizo sand	Tallahatta formation	Covered
				Hatchetigbee formation Bashi marl member	
		Indio formation { Upper Middle Lower	Indio formation { Upper Middle Lower	Wilcox group	
PALEOCENE	Midway			Tuscaloosa sand Salt Mountain limestone Nanafalia formation Ackerman formation and other nonmarine beds	Covered
		Midway formation { Upper Lower	Wills Point	Naheola formation Porters Creek formation	
			Kincaid formation	Clayton formation	

The earliest macrofauna recognized in the Cerralvo area occurs above the shaly clay series in the "*Cardium*" beds, in a sand composed, in part, of broken calcite crystals. Small light-jade grains of glauconite are scattered through it, and a yellow-brown iron compound colors the more indurated layers. The most conspicuous fossils are *Cerastoderma carlotae*, found most commonly in calcareous sandstone



concretions, and *Ostrea eothirsa*, restricted largely to the more indurated layers. Most of the shells are entire, indicating deposition in quiet waters. Such faunas are represented at U.S.G.S. stas. 13471 (B-9)\* and 13460 (B-7). The total thickness of the "Cardium" beds is about 170 feet. Above, are barren, shaly clays 350 feet thick. Furoids are abundant in the 30 to 50 feet of sandstone overlying the clays (U.S.G.S. sta. 13470, B-9), and in the lower, more limy layers *Ostrea eothirsa* is common, and *Cerastoderma carlotae* is not rare. Sandy limestones and limy sandstones directly above the furoidal sandstone (U.S.G.S. stas. 13463, B-9 and 13464, B-9) have yielded among other fossils *Ostrea eothirsa* and *Cerastoderma carlotae*. This fauna is more varied than the preceding and includes a number of gastropods, among them Turritellas, naticoids, a smooth, narrow-whorled cerite-like form in considerable abundance, *Calyptrophorus*, and turrids. The matrix is made up largely of finely shattered, white, brown, and black calcite crystals. The sediments must have been laid down in tranquil waters, for there are very few shell fragments, and the sands are fine and angular.

A fauna of comparable age was collected along a limestone scarp (U.S.G.S. stas. 13459 and 13473, B-6) about 19 kilometers to the north and about 5.5 kilometers south-southeast of Agualeguas. The matrix is a grayish-brown sandy limestone, highly fossiliferous, riddled by the solution of the calcite in the numerous molluscan shells. The limestone is an aggregate of tightly packed, fine calcareous and quartzose sand and masses of crystalline calcite, possibly the redeposited lime recovered from the solution of the shells. The cavities retain the general outline of the shells but are commonly lined with calcite thus obliterating the imprint of the sculpture. The fauna is more diversified than that found east of Cerralvo and has more in common with the Kincaid fauna of Maverick County, Texas, which, like that southeast of Agualeguas, occurs in a resistant, scarp-making limestone. Some of the large and imperfectly preserved gastropods may be identical with those from the Indio Ranch in Maverick County, and the *Calyptrophorus*, though more slender than *C. popenoe*, is similar. Fragments of a *Hercoglossa* resembling the south Texas species, *H. vaughani*, were associated with the gastropods. The pelecypod faunas, however, have surprisingly little in common. *Ostrea eothirsa* and a few other species of the *Cerastoderma carlotae* fauna, abundant both east of Cerralvo and south-southeast of Agualeguas, have not been found in Texas, and there is no trace in Mexico of the explosive appearance of the large Venericardias and of the Callocardias that are so conspicuous in the Kincaid southeast of Eagle Pass. Two other common species in the Agualeguas assemblages, *Pseudoliva nana* and *Volutospina corvocada*, are of unusual interest because of their distribution. They are both dwarfed and have a pathologic aspect, but they are among the few species of Mollusca that are abundant in and common to the Agualeguas fauna and the lower faunas of the Coyote district in the China area. (Cf. U.S.G.S. stas. 13490, D-18, and 13492, D-18.)

Along and near the upper Rio San Juan the relationship of the faunas to one another and to comparable faunas to the north and south is not very clear. Possibly the upper part of the lower Midway is represented in the dwarf assemblage, but in

---

\* See grid on Plate 28.



the Rio San Juan area forms of younger aspect are included, such as slender *Turritellas* of the *humerosa* group, and oysters intermediate between typical *O. eothirsae* and typical *O. thirsae*. Other possibly synchronous or slightly older faunas are those from U.S.G.S. stas. 13489 (D-18) and 13491 (D-18). That from U.S.G.S. sta. 13488 (D-18), on the upthrown side of the faulted section in the Rio San Juan, seems to be of upper Midway age.

*Upper part of Midway formation.*—The faunas of the downstream section on Rio San Juan, U.S.G.S. sta. 13486 (E-18) and the younger 13462 (E-18), and those farther upstream, U.S.G.S. stas. 13487 (D-18) and 13550 (D-18), may all fall within the upper Midway, although several hundred feet of sediments is involved. U.S.G.S. sta. 13462 (E-18), the near-by U.S.G.S. sta. 13649 (E-18), and U.S.G.S. sta. 13450 (D-19) are in outcrops of fine, pearly-gray calcareous and argillaceous sandstones veined with black calcite and highly fossiliferous; even the shells are commonly preserved in the form of black crystalline calcite. These limited faunas cannot be correlated with assurance. In Texas, the fossiliferous beds of the upper Midway are largely restricted to its basal member, which is correlated with the highly fossiliferous Naheola horizon at Matthews Landing, Alabama. Nothing closely comparable to the lower fossiliferous zone of the upper Midway has been recognized in northeastern Mexico, and in both Alabama and Texas the Midway is relatively barren toward the top. *Volutocorbis limopsis*, the widespread guide fossil of the upper Midway in the Gulf, has not been found in Mexico, but fragments of a species of similar size and shape, though differing in sculpture pattern, occur at U.S.G.S. sta. 13462 (E-18).

## EOCENE SERIES

### WILCOX GROUP

*Indio formation.*—The characteristic platy or slabby sandstones and thin-bedded sandy shale and clay of the Indio formation of south Texas are present in northeastern Mexico and have been traced to the Rio San Juan south of China. In south Texas the entire thickness of possibly 850 feet is nonmarine except for a few isolated outcrops; in northeastern Mexico four marine zones or faunules have been recognized in a reported thickness of 3000 feet or more. The lower boundary of the Indio formation is not clearly defined.

No faunal break between the Midway and the Wilcox has been determined. The transition from *O. eothirsae* to *O. thirsae* is not interrupted, and the faunas characterized by an abundance of *Ostrea thirsae* and of *Turritella sanjuanensis* of the *T. humerosa* group have been referred to the upper Midway, although *Ostrea thirsae* is a characteristic fossil of the Nanafalia formation of Alabama, and *Turritella humerosa* of the Aquia formation of Maryland. A similar assemblage, together with *Discocyclus weaveri* Vaughan and the subspecies *parvipapillata* Vaughan, was collected by Paul Weaver and J. M. Minor and later by L. W. Stephenson from the Tanlajás formation in the Plaza in San Antonio, San Luis Potosí. Possibly the evolution of *Ostrea thirsae* was accomplished in the Mexican trough of the Rio Grande embayment, and earlier reef conditions may have prevailed in Nuevo León, while, in Alabama, lignites and other nonmarine deposits were laid down in coastal



lagoons and estuaries. At U.S.G.S. sta. 13485 (E-18), on the Rio San Juan, at one of the highest outcrops from which collections were taken, a very fine-grained grayish or yellowish-brown sandy clay is packed with a large subcircular, corrugated and blackish *Anomia*, recalling that from the sandstone overlying the youngest *Ostrea* beds in the Cerralvo section. On the Rio San Juan the *Anomia* beds are followed by a superb section of evenly stratified and tilted but apparently barren shales, referred by some geologists to the upper Midway and by others to the lower Wilcox. *Anomia* faunas, referred to the base of the Wilcox, were also recovered at U.S.G.S. stas. 13609 (B-5) in Agualeguas, and from 13606 (B-9) and 13458 (B-10) in Cerralvo. Nothing closely comparable is known north of the Rio Grande.

Evidence for the correlation of the Wilcox section in northeastern Mexico with the standard section of Alabama is rather tenuous, and the lower Wilcox alone has been certainly recognized. *Ostrea thirsae*, in Alabama the best diagnostic of the Nanafalia formation, fails as a time indicator in Mexico, probably because of its earlier appearance and development in the western Gulf, and the equivalent of the Nanafalia in northeastern Mexico cannot be defined sharply. In Alabama the Tuscahoma formation is measured by tens of feet; in Mexico a section of several hundred feet in the upper part of the Indio carries a fauna more closely comparable to that of the Tuscahoma than to any other Wilcox fauna. These faunas are to a certain degree sequential and roughly separable into three groups.

The earliest of the three is best characterized by *Venericardia diga*, abundant in the fossiliferous zone east of the *Ostrea thirsae* zone. It is a relatively small, lop-sided *Venericardia* formerly determined as *V. potapacoensis*, a diagnostic species of the Nanjemoy formation of Maryland. The *V. diga* faunas are well developed at U.S.G.S. sta. 13746 (E-3), west of Mier; at a number of localities in Los Herreras; and both to the south and the north of the Rio Pesqueria near La Laja, at U.S.G.S. stas. 13755 and 13756 (E-15) on the Monterrey-Matamoros highway west of China and in and east of the Rio San Juan, both above and below Rancho Altamira at U.S.G.S. stas. 13139, 13140, and 13647, all of them in E-18. *Pseudophragmina zaragoensis* (Vaughan) was collected from this horizon by T. Wayland Vaughan in his earlier studies of the same general area. Heavily calloused specimens of *Voluto-spina* (*Eoathleta*) *tuomeyi* are commonly associated with the *Venericardias* near La Laja and on the highway west of China. They retain no characters by which they can be separated from the Alabama representatives in the Tuscahoma and Bashi formations.

Molds of "*Cardium*," rather common at U.S.G.S. sta. 13461 (D-4), are similar to those recovered by M. R. Jewell on the Texas side of the Rio Grande in southern Maverick County. The outcrop is 190 feet above the base of the Indio, but the thickness of the Indio at this point is not known. The "*Cardium*" fauna in Mexico is probably as old as, if not a little older than, that which includes *Venericardia diga*.

The middle faunal zone in northeastern Mexico is poorly defined. Molds of *Galeodea koureos* and similar forms too imperfectly preserved to be determined specifically are useful in a general way because they may readily be recognized by the characteristic outline of the molds, the form in which they and other species are most commonly preserved. *Galeodea* is not reported south of the Rio Pesqueria,



and, though it tends to occupy the zone intermediate between *Venericardia diga* below and the oyster bed above, it is not dependable. The type of *G. koureos* is from Bells Landing on Alabama River, and in Alabama the species is restricted in its known distribution to the Tuscaloosa formation. In northeastern Mexico, it is recorded in the faunas from U.S.G.S. stas. 13661 (F-9) and 13671 (E-10). A larger and possibly distinct species of *Galeodea* occurs at U.S.G.S. stas. 14021 (D-3), 13714 (E-4), 13681 (E-9), and 13466 (D-11).

The upper part of the Indio in the Mier district is as a rule an indurated gray-blue calcareous sandstone, rather fine-grained, micaceous, and commonly jointed or cross-bedded. At the top a brecciated oyster bed  $\frac{1}{2}$  inch to 8 inches thick is commonly associated with a conglomerate of large brown and reddish-brown pebbles and broken discoidal concretions probably reworked from the lower shale series. Such outcrops have been recognized at U.S.G.S. sta. 13727 (D-2); U.S.G.S. stas. 13725, 13724, and 13723 (E-3); U.S.G.S. stas. 13742, 13719, 13720, and 13718 (E-4); U.S.G.S. sta. 13475 (E-5); and U.S.G.S. stas. 13691 and 13701 (F-5). South of Mier in Los Aldamas, the zone is less characteristically developed. The oyster that enters so largely into the breccia is similar to and possibly identical with *Ostrea intermedoides* Aldrich, described from the Bells Landing horizon of the Tuscaloosa formation. The preservation is inadequate for certain recognition or correlation. However, in these highest horizons of the Wilcox of northeastern Mexico, there are no species that in their range outside of Mexico are restricted to the upper Wilcox. In south Texas, too, all the surficial Indio has been referred to the lower Wilcox, but the higher horizons are presumably concealed by overlap, a relationship indicated by the discrepancies between the outcrop thicknesses and that of the Wilcox in drilled wells. The oyster breccia at the top of the Indio in the Mier district has not been recognized across the border, and the scattered Indio faunas doubtless indicate only local invasions. No Mexican fauna is continuous from the Rio San Juan to the Rio Grande, and only the *Venericardia diga* fauna has been traced from the Rio San Juan to the northern part of the Mier district. Possibly, however, the small Maverick County fauna may be a modification of the *V. diga* assemblage.

#### CLAIBORNE GROUP

*Discussion.*—The sequence of the Claiborne group in northeastern Mexico is exceptional. The thicknesses of all the formations greatly exceed those north of the Rio Grande. Many of the faunas are diversified and well preserved. Their close relationship to faunas described from southern Texas justifies the extension southward of the Texas formational names although the information on the areal geology and field relations is sadly incomplete and local.

*Carrizo sand.*—The Carrizo sand, in northeastern Mexico as in south Texas, whether fresh or weathered, is a conspicuously well defined lithologic unit. It is between 800 feet and 900 feet thick in the Mier sector. In Mexico, as in Texas, it is scarp forming and readily traceable by the resistant dip slopes and characteristic vegetation. Kane and Gierhart (1935) report it as far south as the Rio San Juan. Generically determinable fossils have been found at two localities, U.S.G.S. stas. 13721 and 13722 (E-3). The matrix is a lenticular yellowish-brown



crystalline sandstone with a calcareous cement. The most abundant species is a small 3-noded *Calyptraphorus* resembling a miniature *C. trinodiferus*, the common Bashi species. Nothing in the fauna suggests close correlation with any other known assemblage; in fact no marine fauna has hitherto been found in the Carrizo. The top of the Carrizo sand in the Mier sector is marked by a concretionary conglomerate, probably not a true conglomerate, but indicative of some peculiar phase of estuarine deposition.

*Mount Selman formation.*—In northeastern Mexico, the Mount Selman formation includes over 2500 feet of sediments, mostly shales and sandstones. The scattered outcrops are generally barren except for a small area in southeastern China; even there, only the oysters are well preserved.

In south Texas, in the Bigford, Lonsdale and Day (1937) recovered small faunas at a number of localities, but the Mollusca are all poorly preserved and rather nondescript. Associated with them in several beds are Chara fruits. Among the Mollusca most commonly represented are two or three species of *Trinacria*, two or three mytiloids, a *Callocardia* allied to *C. astartoides*, a *Corbula* allied to *C. smithvillensis* but smaller, at least four cerites, two Bittiums?, a species of *Natica* not far removed from *A. dumblei*, and *Sinum* sp. These forms were distributed through eight zones in the 670 feet included under the Bigford. Neither in lithology nor fauna does the Bigford in Webb County resemble, except in the most general manner, the basal Mount Selman of northern Mexico.

An exceptionally fine outcrop, probably of basal Mount Selman age, is displayed on either side of the Rio Salado near the bridge west of Guerrero, Tamaulipas (U.S.G.S. sta. 13228, north of area shown on map). About 5 feet of highly fossiliferous calcareous sandstone is overlain by about 20 feet of bedded sands and sandy clays, in which no fossils were observed, and underlain by bedded clayey sands that at relatively low water form the stepping stones across the Rio Salado. The sandstone carries a unique fossil assemblage including *Cerithium* in great abundance, common oysters resembling *O. gierharti* but larger and thinner, and a coarsely ribbed *Brachidontes*.

The earliest Claiborne faunas in Mier and Los Aldamas are from a zone in the lower 100 feet of the Mount Selman characterized lithologically by "cannon ball" concretions in a fine-grained, thin-bedded, brownish-gray calcareous sandstone. The matrix of the concretions is calcareous and ferruginous, commonly oxidized to a strong reddish brown and full of small oölitic grains of jade-green glauconite. The fossils, which occur sparsely in both the sandstone and the concretions, are rarely determinable specifically. Oysters and oyster fragments, usually broken before deposition, are common; the locally abundant *Corbula* (*Vari-corbula*) sp. is similar to *C. smithvillensis* but not so large. *Aturia?* sp., described by Miller and Furnish, 1938, was collected from the concretionary zone at U.S.G.S. sta. 13262 (F-11), 7 kilometers southwest of Estación Aldamas and 60 to 100 feet above the base of the Mount Selman.

*Ostrea gierharti* probably represents a higher horizon. It was described from the Mount Selman on the south side of the Rio Grande opposite San Ygnacio, Texas, and later recovered from U.S.G.S. sta. 13989 (F-1), about 64 kilometers south-



southeast of San Ygnacio, and U.S.G.S. sta. 13988 (F-5), about 27 kilometers still farther to the south.

These meager faunas of Mier and Los Aldamas represent only a very small part of the original assemblage. From many hundreds of feet of Mount Selman sediments, no faunas have been recovered, and, from the imperfect and scattered evidence available, no zonal correlation can be attempted. However, except for the outcrops of *Ostrea gierharti*, probably only the lower part of the Mount Selman is represented in Guerrero, Mier, and Los Aldamas.

During upper Mount Selman time, however, shallow-water marine conditions apparently prevailed in both the eastern and the western Gulf. The *Ostrea lisbonensis* zone can be traced along an interrupted line of outcrop from Alabama River through the Winona sand member of the Lisbon formation of Mississippi; the Cane River formation of Natchitoches and Bienville Parishes of Louisiana; the Weches greensand member of the Mount Selman of East Texas; and, after a long hiatus, to the upper part of the Mount Selman of southeastern China near the Nuevo León-Tamaulipas state line.

There is no evidence of more than one reef in the outcrops of abundant *O. lisbonensis* north and south-southeast of Rancho Presa Nueva, in Santa Ana, China, Nuevo León. Good collections were made at U.S.G.S. sta. 13603 (H-15); stas. 13622 and 13589 (L-23); sta. 13623 (L-24); sta. 13635 (M-24); and sta. 13630 (M-25). The only determinable species found in association with the oyster is *Chlamys burlesonensis*, which on the Brazos River is said to be restricted to a 20-foot zone at the base of the Weches greensand member of the Mount Selman.

The hard red-brown glauconitic and calcareous sandstone outcropping at U.S.G.S. sta. 13626 (L-24) is slightly lower than the *O. lisbonensis* horizon, and below the indurated bed are soft gray and buff sandstones (U.S.G.S. sta. 13627, L-24) containing an abundance of the characteristic Weches species, *Lutetia texana*.

Above the *Ostrea lisbonensis* zone in Santa Ana, gray to buff calcareous, glauconitic, and fossiliferous sandstones carry Discocyclinas, similar to those locally abundant in the Tallahatta formation of Alabama and the Cane River formation in Louisiana. Comparatively few Foraminifera are found at the extreme base in the zone represented by U.S.G.S. stas. 13633 and 13628 (L-24), but they become increasingly common toward the top. The molluscan fauna is diversified but not well preserved. *Lutetia texana* is among the species represented, and possibly *Chlamys burlesonensis*. The microfauna becomes more prolific, the macrofauna more restricted at the slightly higher horizon represented by U.S.G.S. stas. 13621 (L-23), 13632 (L-24), and 13631 (M-25). The locally abundant *Tubulostium cortezi* was described from this last locality. The foraminiferal zone marks the top of the unquestioned Mount Selman in southeastern China.

*Laredo formation.*—The Laredo formation, a name which replaced "Cook Mountain" in the Rio Grande embayment, is faunally the most important Tertiary formation. During Laredo time, deposits were laid down in three basins and were controlled, apparently, by conditions which did not encourage a free interchange of faunas, though some of the disparity is doubtless due to the accidents of collecting. The faunas most closely comparable to those of south Texas are naturally found in



the canton of Mier; the most complete series is from Los Aldamas, Doctor Cos, and General Bravo; and that showing best the relationship to the underlying Mount Selman is the series from southeastern China.

The Laredo section in south Texas has been worked in considerable detail. It offers a wide range of variation, and the evidence of shallow-water conditions is greater in the northern outcrops. The oldest Laredo faunas, as they are developed on the eastern banks of the Rio Grande above Laredo and on Manados Creek, have not been identified in the Mier district. A small fauna comparable to that from Arroyo Chacon, on the eastern outskirts of Laredo, was recovered from U.S.G.S. sta. 13986 (G-2). A similar but larger and more diversified assemblage occurs 15.7 kilometers west of Mier on the Cerralvo road (U.S.G.S. sta. 13479, F-4). In the Texas section, the Arroyo Chacon fauna is considered to be of lower middle Laredo age, and in the Mier section it is found about 300 feet below the base of the *Turritella cortezi* horizon. Synchronous faunas have been reported from outcrops north and west of Mier. The well-defined *T. cortezi* zone has been recognized in Mexico for many years, and more recently *T. cortezi* has been used as a guide fossil in south Texas. East of Zapata on the Hebbronville road, there are two *T. cortezi* beds separated by an interval of 30 feet. Stenzel (1940) reported the same species from Leon County and considered that the zone, which had been followed in south Texas through Zapata and La Salle counties, is the equivalent of a lentil 20 to 25 feet thick traced from southern Leon County to Hurricane Bayou in central Houston County, Texas. In the Mier sector, *T. cortezi* is conspicuously abundant in a crescentic area west of the town. The matrix may be a soft grey gypsiferous shale, a hard gray or brown limestone, or a soft sandstone. The small associated fauna includes *Tellina mooreana*, *Callocardia amichel*, *Pteropsis lapidosa*, *Architectonica* sp. possibly *A. alveata*, a large cerite, *Buccitriton* sp., *Cornulina armigera*, *Falsifusus carexus*, a relatively large coarsely ribbed volute similar to *Volutocorbis? wheelockensis*, and *Hesperiturris amichel*. Within the upper part of the Laredo is a reddish sandstone, which carries a rather similar fauna except for the absence of *Turritella cortezi* and the appearance of a conspicuous number of large gastropods, such as *Lacinia* and the large *Ampullina dumblei*. Between the heavy sandstone overlying the *T. cortezi* horizon and the series of gypsiferous clays and oyster beds a little above the actual Laredo-Yegua contact is a sandstone series including in the lower half a thin basal conglomerate and some fossiliferous shales and concretionary beds. Fairly good faunas that do not differ greatly from those of the middle part of the Laredo have been recovered from several such stations on the outskirts of Mier. The large cerites are probably a facies character. Similar but not identical forms occur in the lower part of the Laredo in the Manados Creek section in Webb County, on the high northwestern bank of the Rio Grande about 2 miles downstream from Zapata, and in the railroad cut on the western edge of Charlotte in Atascosa County. Associated with the cerites at a few localities in the upper Laredo near Mier are very large depressed turbinate gastropods. Such forms have been recovered from U.S.G.S. stas. 13767 (G-3), and 13943 and 13944 (H-3). The oyster beds outcropping within the town limits of Mier are considered basal Yegua.

Probably the true basal Laredo fauna is not represented in Los Aldamas, Doctor



Cos, General Bravo, and northern China. In most of the area the lowest beds recorded are characterized by an abundance of large *Ostrea sellaeformis* and of solitary corals such as *Balanophyllia* sp. cf. *B. irrorata* and *Flabellum cuneiforme*. Nothing comparable is known in south Texas, but Stenzel (1936) identified an old *Ostrea sellaeformis* reef at the base of the "Crockett marl" on the Brazos River at Stone City in Brazos County. Underlying the oyster reef are 85 feet of Stone City beds and 300 to 350 feet of Sparta sand. In western Alabama the lowest of the *O. sellaeformis* beds appears about 30 feet above the highest *Ostrea lisbonensis* horizon. A single collection, U.S.G.S. sta. 13619 (H-17), made near the Cantú ranch house a few miles south of the General Bravo-China canton line, came from a 1-inch bed of hard brown concretionary limestone in the clays overlying the Mount Selman sandstones. The fauna cannot be determined specifically, but it includes oysters and a solitary coral, abundant *Nucula*, *Atrina*, *Dentalium*, small *Turritella*, and other forms. The fauna associated with *O. sellaeformis* and the corals is one of the most varied and well preserved of those recorded from the Laredo of Mexico. Among the fellow species are *Crassatellites antestriatus*, *Venericardia densata*, *Callocardia tornadonis*, *Corbula engonatoides*, *C. smithvillensis*, *C. conradi*, *Neverita limula ceryx*, *Personella septemdentata*, *Falsifusus mortoniopsis*, *Volutospina clayi* (Smith), *Latirus moorei*?, *Mitra polita neta*, *Clavilithes*? sp., a very large form, *Coronia margaritosa*?, *Eosurcula moorei*, *Leptosurcula beadata*?, *Cochlespira bella*?, and *Conus santander*. The fossils occur for the most part in yellow to orange calcareous and ferruginous concretions in dark shale; in gray concretionary sandy limestone; and in thin beds of calcareous sandstone in dark shale. The highly fossiliferous concretionary bed at U.S.G.S. sta. 13596 (H-15) is not more than 100 feet above the top of the Mount Selman. Oysters and solitary corals are abundant, and similar faunas characterize near-by outcrops.

Other localities, such as U.S.G.S. sta. 13559 (H-12), 13602 (H-16), 13597 (I-18), 13969 and 13970 (I-19), 13971 (I-20); and 13967 (J-20) carry *Ostrea sellaeformis* but few or no corals. Although U.S.G.S. stas. 13454 and 13600 (H-15) and sta. 14054 (I-17) have been referred to the lower part of the Laredo, they are probably above the *Ostrea sellaeformis* zone, for they contain abundant *Turritella nasuta*, a species commonly associated with the faunas of the lower middle part of the Laredo.

The middle part of the Laredo may be characterized as the *Volutospina lapparoides* zone. The species is widespread throughout that horizon from a little north of the Rio San Juan almost to the Monterrey-Reynosa highway. On the Texas side of the Rio Grande, a similar fauna in a similar matrix was recovered from the river bank below La Perla ranch house. The matrix is characteristically a brownish-gray calcareous, glauconitic sandstone interbedded in buff sandstone and shale. The finest faunas are those east of Doctor Cos at U.S.G.S. stas. 13567 (H-11); and 13569, 13570, 13565, and 13566 (H-12). Among the species associated with *V. lapparoides* at these localities are *Calorhadia* (*Litorhadia*) sp. cf. *C. (L.) bastropensis*, *Plicatula euplecta*, *Sphaerella anteproducta*, *Callocardia amichel*, *C. tornadonis*, *Pholadomya* sp., *Architectonica alveata*, *Turritella nasuta*, *Neverita limula ceryx*, *Pseudoliva carinata*?, *P. santander*, *Cornulina armigera* (rare), *Lacinia santander*, *Falsifusus carexus*, *Latirus moorei*, *Mitra polita neta*, *Olivula punctulifera*, *Michela*



*trabeatoides*, *Hesperiturris amichel*, *Coronia genetiva?*, *Surculites cortezi*, *Microdrillia harrisi?*, *Conus highti* and *Terebra* sp. cf. *T. texagya*. Scattered outcrops to the north, U.S.G.S. sta. 13557 (H-10) and stas. 13685 and 13800 (H-9), are also fossiliferous and of middle Laredo age; to the south are U.S.G.S. stas. 13555 (H-14); 13590 (I-13); 13554 and 13556 (I-14); and 13553 (H-15). The excellent faunas at U.S.G.S. stas. 13990 (H-9) and 13547 (I-14) may be a little lower.

The upper part of the Laredo in the central area is not well represented faunally. The matrix is most commonly a gray calcareous concretionary sandstone or chalky limestone weathering grayish white. The faunas are meager, and the *Chlamys capajouda* is perhaps the most characteristic species at U.S.G.S. stas. 13542 (J-13) and 13545 (J-15), the most fossiliferous of the few outcrops. The horizon was determined on field evidence to be comparable to that below the basal Yegua oyster bed outcropping in the town of Mier.

The section in southeastern China is unique in the Claiborne of the western Gulf in that it carries both *Ostrea lisbonensis*, the marker of the Mount Selman formation, and *Ostrea sellaeformis*, a guide fossil of the Lisbon of Alabama and Mississippi and of synchronous formations. The two oysters in question are not found in a single outcrop but in near-by outcrops north of Rancho El Hueso. The specimens of *Ostrea sellaeformis* (U.S.G.S. sta. 13620, L-23), are large, typical individuals in red and yellow iron-stained concretions in dark shales. There is no associated fauna, and no other outcrop yielding *Ostrea sellaeformis* is reported in the area.

Grayish limy sandstone peppered with glauconite and weathering brownish outcrops southeast of Rancho Presa Nueva, near the head of Arroyo Las Estacas. The calcite is highly crystalline and commonly yellowish. Molluscan molds are numerous, but there are very few well-preserved shells. The faunas include a Pecten of the *Chlamys burlesonensis* group, fairly abundant at several localities, *Amaurellina* sp. close to *A. singleyi*, *Crassatellites* sp. cf. *C. clarkensis*, and a *Callo-cardia* resembling *C. amichel*. The following collections are similar both lithologically and faunally and cannot differ greatly in age: U.S.G.S. sta. 13634 (M-24); stas. 14148, 13640, 13643, 13644, and 13645 (M-25). *Chlamys* and *Crassatellites* are not recorded from U.S.G.S. stas. 13639 and 13641 (M-25), and a number of species of small bivalves and univalves are present that were not observed in the other collections. The differences may be due to facies only or to a slight difference in age. U.S.G.S. sta. 13643 (M-25) is conspicuously rich faunally and is possibly a little younger than the other Claiborne outcrops in southeastern China. However, the common volute cannot be separated from *Volutospina lapparoides*, the zone marker of the middle part of the Laredo formation in Nuevo León and Tamaulipas. If the entire series above the oyster reef is of middle Laredo age, the *Ostrea sellaeformis* bed is the only record of the lower Laredo fauna in southeastern China, and the upper fauna is not recorded.

*Yegua formation.*—The Yegua formation is, for the most part, nonmarine. The Mier oyster beds and their equivalents roughly indicate the base, a contact essentially the same as that traced by Trowbridge in 1923. The lower Yegua in a limited area in south Texas and in Mier, Mexico, includes about 60 feet of basal shale, clay, sand, and oyster beds and about 100 feet of scarp-making sandstone. The Yegua sands



are grayer and more mealy than those of the Laredo formation, and, if bedded, the beds cannot be followed for any distance. The clays at the foot of the scarp are in pastel shades of purple and green and support a sparse but highly characteristic vegetation such as lecheguilla and ebanito, from which the Mexicans make coffee. A small marine fauna is recorded at the top of the clays at the foot of the scarp. Above the sandstone the sequence is repeated. Other oyster beds not so thick as those outcropping in Mier are interstratified with cross-bedded sands, sandy clays, and maroon and greenish gypsiferous clays capped by scarp-making sandstones. The total thickness according to Kane and Gierhart (1935) exceeds 1500 feet. Local and probably brackish-water faunas have been collected from the gypsiferous clay at U.S.G.S. sta. 13496 (I-4) and from the platy sandstone at U.S.G.S. sta. 13494 (H-3). The basal bed of the Jackson of Kane and Gierhart (1935) is referred in this report to the upper Yegua. It includes well over 100 feet of sand, shale, and lignite and is typically exposed at Los Guerras, a small Mexican community on the Rio Grande, 4 miles above Roma. A faunule of exceptional interest is contained in a dark-gray sandy clay a little above the top of the lignite. The assemblage includes a few abundant gastropods, some of them possibly of brackish-water origin; pelecypods are rare except for oysters which lie at a slightly higher level. The shells are silicified and chalcedonized although no ash bed of comparable distribution has been recognized. The zone has been traced from a point southeast of Mier, north through Starr and Zapata counties, Texas, to Atascosa County, a distance of more than 320 kilometers in an air line. Representative collections were made at U.S.G.S. stas. 13499, 13500, and 13497 (I-4); sta. 13750 (J-6); stas. 13966 (J-7) and 13745 (J-8); U.S.G.S. sta. 14053 (L6-L7); and the following localities in Texas: U.S.G.S. sta. 13997,  $3\frac{1}{2}$  miles northeast of Salineño; an unnumbered collection 4.1 miles northeast of Salineño; and U.S.G.S. sta. 14172, 1 mile east of Sandalio Ramos Ranch, all three localities in Starr County; an unnumbered collection from 14.63 miles east, 1 mile N.  $30^{\circ}$  E. of court house, Zapata County; and an unnumbered collection from the C. T. Tom ranch, 4 miles southeast of Campbellton, Atascosa County. In the outcrop east of Zapata, the following section was made by M. E. Roberts:

	Feet
Bed of large oysters. ....	2
Clay weathering brownish-yellow. ....	12
Small broken oysters. ....	2
Sandy clay; abundant gastropods. ....	8

The fresh-water fauna (U.S.G.S. sta. 13498, I-5), represented by small opalized fossils in a 3-inch chalcedony bed, is said to be synchronous. A zone of yellowish-brown selenitic clays and sandy clays with interbedded ripple-marked flags marks the top of Los Guerras. The clays carry hard gray calcareous and fossiliferous concretions; most of the fossils are molds. The faunas are truly marine, but none of them is very well characterized, and on fossil evidence alone the age is difficult to determine. A small *Venericardia* of the *rotunda* type is common, but there are no *Venericors*. The most representative collection is probably that from U.S.G.S. sta. 13749 (K-7); the matrix is a sandy coquina out of which the shells have been



leached. Other collections from horizons near the top of the Yegua were made at U.S.G.S. sta. 13736 (J-6); U.S.G.S. stas. 13748, 13737, and 13739 (K-7).

#### JACKSON FORMATION

*Discussion.*—The information on the macrofaunas and the field relations is not satisfactory. The microfaunas are excellent and apparently better characterized than most of the Mollusca. Although the Jackson in northeastern Mexico is potentially a group, it is treated as a formation in this report. Like the formations of the middle and lower Eocene, the Jackson is much thicker south of the Rio Grande than it is north of it.

*Roma sandstone.*—The Roma sandstone of Kane and Gierhart (1935) is considered the basal member. The name is taken from the county seat of Starr County, Texas. The town overlooks the Rio Grande from the top of a bluff over 60 feet high, an elevation due to the massive light-gray, rather soft, fine-grained selenitic sandstone more than 30 feet thick, and the layer of bluish-gray concretionary and crystalline limestone which caps the sandstone. Both the sandstone and the concretions are fossiliferous, but the fossils are preserved in the form of molds only and show up as reddish-brown stains on the grayish-tan sandstone. The fauna in the bluff above the International Bridge at Roma includes mostly bivalves, *Tellins*, *Gari*, *Spisula*, and *Corbula*, with a few gastropods such as *Ficus*. The outcrops of the Roma sandstone from which collections have been taken for this report are concentrated in or near the Rio San Juan, between the Camargo-Mier canton line and the mouth of Rio San Antonio. They include U.S.G.S. sta. 13738 (J-6); U.S.G.S. stas. 13753, 14026, and 14025 (K-7); U.S.G.S. stas. 14027 and 13740 (K-8). At several of the outcrops, notably U.S.G.S. stas. 13738, 14025, and 14027, the Roma sand is packed with *Corbula* molds.

*Jackson formation undifferentiated.*—In northeastern Mexico, the earliest well-characterized fauna (U.S.G.S. stas. 13504, M-8 and 13503, N-8) above the Roma sandstone is of lower or middle Jackson age. The fossils occur in a 10 to 15 foot lens of fine-grained calcareous sandstone or sandy limestone overlain and underlain by the gypsiferous clays and sandy clays which replace the fossiliferous sandstone to the south. Among the common and characteristic forms are *Callocardia* sp. cf. *C. securiformis*, *Buccitriton hilli jacksonensis?*, a *Mazzalina* which may be *M. inaurata*, *Ancillopsis subglobosa?*, *Caricella subangulata?*, *Volutospina symmetrica*, and *Conus tortilus*. An excellent specimen of *Turritella arenicola* was collected at U.S.G.S. sta. 13504; the species is abundant at U.S.G.S. sta. 13508 (M-5 and M-6) 1 kilometer north of Nuevo Camargo and at the Alta Vista ranch house in Starr County, Texas. The Starr County outcrop has been tentatively referred by the micropaleontologists to the McElroy or middle Jackson.

The distribution of the larger fossils in the upper part of the Jackson in northeastern Mexico seems to be controlled to a considerable degree by the ecology. A soft gray argillaceous sandstone containing rounded calcareous concretions is exposed in Arroyo San Antonio (U.S.G.S. sta. 13527, M-11). Both the sandstone and the concretions are fossiliferous. Many of the concretions are formed around *Pinnas* resembling the *Atrina jacksoniana* Dall but larger than the typical species. A



similar form is rather widely distributed in the Caddell clays of the lower Jackson of eastern Texas and its occurrence in "yellow, sandy concretions" is mentioned by Dumble, 1920, p. 171. Directly below the Pinna zone, at U.S.G.S. sta. 13524 (M-11), microfaunas referred to the upper Jackson were collected from yellowish brown sandstone containing quartz pebbles and shell fragments. The upper Jackson also includes brown clays heavily impregnated with crystalline calcite (U.S.G.S. sta. 13529, M-11); concretionary brown and gray sandstone containing abundant orbitoids and poorly preserved mollusca (U.S.G.S. sta. 13598, L-11); and a coquina from which all the shells have been leached leaving in the soft gray to buff fine-grained sandstones only a mass of molds, most of them of small bivalves (U.S.G.S. sta. 13520, N-10). The outcrop of massive, highly fossiliferous sandstone boulders at U.S.G.S. sta. 13513 (M-11) has yielded the most prolific and best preserved of the small gastropod faunas; the thin brown calcareous sandstone at U.S.G.S. sta. 14009 (M-13) offers the best assemblage of the larger bivalves and univalves. Operculinas of Jackson age are recorded from a grayish tan lenticular sandstone in southeastern China east of Presa Nueva (U.S.G.S. sta. 13637, M-24) and from a 2 to 4 inch bed of light-brownish limestone at U.S.G.S. sta. 13638 (M-24).

### OLIGOCENE SERIES

#### GENERAL STATEMENT

Two well-characterized and well-differentiated faunas have been recovered from the Oligocene series of northeastern Mexico; the lower, allied to the faunas from the Vicksburg group, the upper, to those from the Chickasawhay and Suwanee limestones of the eastern Gulf Province. The so-called "Vicksburg" fauna has been recognized in a lower marine sandstone, presumably of lower Oligocene age, and in an upper marine sandstone, presumably of middle Oligocene age. The two marine beds are separated by nonmarine sediments, typically red and green bentonitic clays comparable to the Frio clay. The upper sandstone is locally silicified and scarp-forming. Although the Vicksburg age of both sandstones seems clearly indicated by the organic remains, the faunal zones within the Vicksburg group have not been identified. *Ampullina mississippiensis*, which in the eastern Gulf Province is restricted to the lower and middle Vicksburg, has been recognized in northeastern Mexico only in the ashy beds of the upper sandstone overlying the bentonitic clays. This and other anomalous distributions cannot yet be satisfactorily explained. The Oligocene series in Mexico is measured in thousands of feet; the fauna is known from a relatively few isolated outcrops.

#### LOWER AND MIDDLE OLIGOCENE

*Lower marine sandstone.*—A brownish tan or gray, medium-grained, locally conglomeratic, calcareous concretionary sandstone is well exposed near the base of the series in Nuevo León. The conglomerates and concretionary beds are highly fossiliferous. Some of the faunas, notably the collections from U.S.G.S. sta. 13509 and 13510 (M-11), include species such as *Aturia alabamensis* (Morton) formerly associated only with the Jackson age, and, in my earlier reports, I assigned these faunas to the Jackson, possibly misleading other workers, which I regret. With



further study, the more modern elements, *Chione* for example, became increasingly significant, and the belief in the Jackson age of the faunas untenable. Other good faunas from near the base of the Oligocene were collected at U.S.G.S. stas. 13505 (N-8), 13518 (N-10), 13521 (M-10), 13511 and 13522 (M-11), 14056 (M-12), 13531 (M-13), and 13537 (M-14). The faunas most closely comparable with those from Nuevo León are the Vicksburg faunas of Mississippi and Alabama, possibly because the Mollusca of the basal and lower Oligocene are not well represented in the western Gulf Province. The considerable thickness of massive sandstone that overlies the basal Oligocene is apparently less fossiliferous than the underlying conglomerates and concretionary sandstone. The outcrops are few, and the collections meager. Farther south in Carlos Cantú, China, a lighter colored, finer grained, and usually softer sandstone may be synchronous with the lower marine horizon. Excellent faunas of Vicksburg age were recovered at U.S.G.S. stas. 14147 (O-22), 14144 (P-22) and 14146 (P-23). The echinoids and a colonial coral determined as *Antiguastrea cellulosa* (Duncan) from U.S.G.S. sta. 14146 point to a horizon in the Vicksburg higher than that indicated by the Mollusca.

*Nonmarine bed.*—The red and green clay zone is not favorable to exposures. The few fossils are from outcrops protected by the resistant sandstones above. The fauna includes little more than oysters (U.S.G.S. sta. 13502, N-7) and impressions of non-marine Mollusca (U.S.G.S. sta. 13530, O-13) in green bentonitic clay. Coarse-grained, thin-bedded, ashy sandstone overlies the clay at the second locality.

*Upper marine sandstone.*—Near Rancho Miralejas (U.S.G.S. sta. 13993, O-10) similar bentonitic clays and ashy sandstone are overlain by a thin bed of partially silicified oysters and other bivalves. The common fossil is a species of *Venericardia* known only from molds but probably allied to *V. carsonensis* Dall described from the Red Bluff Clay. Associated with the Venericards are large oysters, some fossil wood, and poorly preserved specimens of *Ampullina mississippiensis*. The silicified faunas which include *A. mississippiensis* are best represented at U.S.G.S. stas. 14023 (N-13) and 13539 (N-17). *Ampullina* is abundant, and associated with it are fossil wood, the brackish-water *Erodona*, the fresh-water *Hemisinus*, the land shell *Holospira*, and a number of truly marine species, such as *Sinum mississippiense*, *Ficus mississippiensis*, and *Oliva mississippiensis santander*.

Large, low-spreading gastropods, possibly *Helix s. l.* near *Lysinoe* sp., were recovered in abundance from the hard conglomeratic, shaly, locally silicious sandstone outcropping at U.S.G.S. sta. 13517 (N-15). Though the generic determination is uncertain, the species suggests a nonmarine habitat. It is apparently the same form as that which occurs in the fauna at U.S.G.S. sta. 14023 (N-13), which may have been established near the mouth of a stream where both land and estuarine species were brought in and laid down together with the resident marine fauna.

The small faunas at the top of the marine section near Rancho Laguna de los Indios, U.S.G.S. stas. 13533 and 13532 (O-19), and that 10 to 15 miles to the north, U.S.G.S. sta. 13534 (O-17), include little more than fragments of a *Pecten* related to *P. byramensis* and a small *Ostrea* similar to *O. vicksburgensis*. The fossils have not been correlated satisfactorily with the more prolific marine faunas north of the Monterrey-Reynosa highway and are perhaps more closely related to those near



Mendez. The field relations indicate that the brown-weathering clays in which the shells occur are high in the upper marine series.

#### UPPER OLIGOCENE

The outcrops along the Rio Conchos in the vicinity of Mendez offer an exceptional sequence of fossiliferous upper Oligocene. The faunas north of Mendez and on the Conchos above Mendez were recovered from the upper tenth of a section more than 500 feet thick. Two horizons distinct in lithology and in fossil content are included: a light gray to creamy white limestone weathering dark gray containing a fauna allied to that of the Chickasawhay and Suwanee limestones; and an overlying brown to brownish gray medium grained sandstone, containing several species closely related to the Vicksburg faunas. Both faunas seem influenced by the shore life of the Caribbean region and Panama. The *Turritella* abundant in the upper sandstone at U.S.G.S. sta. 13582 (O-25) is close to an undescribed species from U.S.G.S. stas. 8468 and 8469 in the Oligocene of the Canal Zone. A slightly younger fauna, U.S.G.S. sta. 13581 (P-25), includes echinoids referred tentatively by C. Wythe Cooke to *Eupatagus*, and Pectens similar to *Pecten byramensis* except for a flattening of the disk toward the umbones. The same *Pecten* and *Ficus mississippiensis* are abundant in hard brown sandstone at U.S.G.S. sta. 14034 (P-25). The *Pecten* horizon in the Mendez area is overlain by a coral limestone (U.S.G.S. sta. 14036, P-25).

The gray, sandy limestone, 25 to 30 feet below the *Pecten* horizon at U.S.G.S. sta. 14035 (P-26), contains large echinoid spines, orbitoids, and tubes similar to *Kuphus incrassatus*, widespread in the upper Oligocene of the Gulf Province and the Caribbean region. A much distorted specimen of *Orthaulax*, a genus restricted in its known distribution to the upper Oligocene and lower Miocene, is common at U.S.G.S. sta. 14033 (P-25); with it are associated internal molds of *Phacoides* and *Metis*, a few indeterminate *Turritella* and a number of *Kuphus* tubes. In the limestone assemblage of the Mendez area, as in the Chickasawhay and Suwanee limestones, many of the lower Miocene forms of the eastern Gulf Province are foreshadowed. *Trigoniocardia* is included, a genus formerly supposed to make its first appearance in the lower Miocene but later recognized in the Suwanee limestone; *Divaricella*, exceedingly rare in pre-Miocene faunas; *Nerita tampaensis* and an *Ampullina* similar to *A. amphora* from the Tampa; *Orthaulax pugnax* s.l.; and many cerites, a group common in both the Chickasawhay and the Tampa. The very shallow-water or even brackish-water deposition clearly indicates a type of sedimentation common to the upper Oligocene and lower Miocene of the eastern Gulf Province.

About 9 kilometers south of Mendez at U.S.G.S. sta. 13583 (P-27), a small land shell probably referable to *Holospira* is exceedingly abundant. The forms are similar to those from U.S.G.S. sta. 13510 (M-11). Unfortunately, the records of the land gastropods are too few and too scattered to be of much use stratigraphically.

#### MIOCENE SERIES

##### LOWER MIOCENE

*Guajalote formation.*—Toward the close of the lower Miocene or the opening of the middle Miocene, the waters of the later Tertiary Gulf of Mexico withdrew to



approximately the present shore line. The narrow overlap from north of the Río Conchos near San Fernando to an undetermined location at least 150 miles south of Tampico may have been interrupted between the Río Conchos and Tampico. In any event, the rich fauna that inhabited those shores was similar throughout, and in it is offered the earliest close tie between the Tertiary macrofaunas of the Río Grande and those of the Tampico embayments. The southern deposits have been called the Tuxpam or Tuxpan formation; this name has been used by some authors for the beds along the Conchos. Because the basins may have had a slightly different development and because the northern basin may include a considerably longer sequence than the southern, it has in this report been given a name of its own. San Fernando and San Rafael, used by Dumble, are both preoccupied. The replacement name offered is that current for many years among the field men of the Huasteca Petroleum Company, who called the deposits the Guajalote formation, from the Rancho Guajalote northwest of San Fernando. Undoubtedly the lower fossiliferous sandstone, which, in the San Fernando area, carries the well-characterized *Nodipecten* fauna, should be correlated with the *Nodipecten* fauna of the Tuxpan. Whether or not the higher zone represented at San Fernando is present in the Tuxpan has not been determined. The field relations indicate that the *Nodipecten* beds of the Guajalote lie some 2500 feet above those of the upper Oligocene, and that the higher fossiliferous horizon of the Guajalote is separated from the lower *Nodipecten* fauna by an interval of about 250 feet.

The fauna of the Guajalote formation was one of the first of the northeastern Mexican faunas to be recognized and correlated. The collections made in the reconnaissance expedition of W. F. Cummins in 1908 were sent to W. H. Dall, who recognized in them, species similar to or identical with those of the Alum Bluff fauna of Florida, which at that time was referred to the Oligocene. Perhaps the most conspicuous form both in the San Fernando area in which the Guajalote outcrops and in the Tuxpan is a *Nodipecten* determined in the earlier check lists as *Pecten* (*Nodipecten*) *condylomatus* Dall. This species has served as the key to the correlations. It is abundant and diagnostic and sufficiently well preserved to be determined with assurance. It is very closely allied to *Nodipecten condylomatus* Dall, a guide fossil of the Chipola, the lowest of the three formations included in the Alum Bluff group, although there are certain constant differences considered sufficiently important to be recognized in the taxonomy. These same differences were noted in the *Nodipecten* from Whites Creek, a Florida locality of somewhat conjectural field relations but probably in the lower part of the Shoal River formation, the upper unit of the Alum Bluff. The *Nodipecten* fauna is typically developed at U.S.G.S. stas. 13584 and 13585 (V-29); and at U.S.G.S. stas. 13587 and 13588 (W-30). Associated with the *Nodipectens* are *Scutella cazonensis* Kew, found also at U.S.G.S. sta. 13732 (T-16); abundant molds of the double valves of *Arca*; a *Chlamys* apparently related closely to *C. nicholsi* of the Alum Bluff; a large *Lyropecten*; an abundant *Cerastoderma*, apparently a new species related to *C. waltonianum*; *Clementia* (*Egesta*) sp. cf. *C. (E.) grayi* Dall; an *Architectonica* of the *A. quadriseriata* group; *Turritella subgrundifera*?, a *Sycotypus*, Olivas, crab fingers, and a vertebra of a porpoise. The fauna from U.S.G.S. sta. 13455 (W-29) is a little higher than the preceding



faunas and includes no *Nodipectens* and no echinoids. No other important difference was obvious, and the absence of *Nodipecten* and the echinoids may be due to the accidents of collecting.

In the Río Conchos section the fossiliferous sandstone is overlain by about 250 feet of soft, medium- or fine-grained sandstone, for the most part barren except for oyster fragments. Above the barren horizon is a 4-foot bed of rather soft medium-grained creamy-tan sandstone specked with some melanitic mineral, "mildewed" with iron stains and locally packed with molds of single valves of what seems to be a species of *Spisula* (U.S.G.S. sta. 14048, V-29). A few other forms, *Arcas*, *Cerastoderma* sp., and *Chione* sp. occur, though not in the *Spisula* layers. A slightly more indurated, more deeply colored, and much thicker sandstone succeeds the *Spisula* zone (U.S.G.S. sta. 13586, V-29). The fossils, except for the absence of *Nodipectens* and echinoids, are similar to those 250 feet below and like them are preserved only as molds. Several species of *Anadara* are included, none of them determinable, a new species of *Cerastoderma*, a common *Chione* (*Chamelea*) sp., and an *Ochetoclava* closely related to a *Chipola* form.

#### MIDDLE MIOCENE

*Oakville sandstone*.—A resistant scarp-making sandstone identified with the Oakville has been traced with interruptions almost 100 kilometers south of Reynosa. A number of collections were made, but they do not include a fauna sufficiently diagnostic to establish through the macrofauna the relative ages of the scarp and the higher beds of the Guajalote formation.

A very hard sandy limestone (U.S.G.S. sta. 14051, R-11) closely meshed with the pits of former oölites is exposed on hills of probably Oakville age; no organic remains were determined. Farther south, a highly resistant calcareous sandstone, packed with the partially dissolved shells of small indeterminate bivalves, (U.S.G.S. sta. 14040, R-14), overlies a bed of large oysters similar to *O. normalis* Dall and *O. cahobasensis* (U.S.G.S. stas. 14038 and 14039, R-14). A similar sequence of a calcareous sandstone carrying numerous indeterminate molds of small bivalves, U.S.G.S. sta. 14042 (S-15), and overlying large oysters, U.S.G.S. sta. 14041 (S-15), is repeated farther south along the scarp. Much of the sandstone in the southern sample carries dark quartz. The sandstone from the irrigation ditch at Campo La Llorona, U.S.G.S. stas. 14043 (S-16) and 13732 (T-16), is similar to that from U.S.G.S. sta. 14040, but contains a larger quantity of crystalline calcite, is a deeper yellow, and weathers to a brick red. Excellent remains of *Portunus* (*Portunus*) *haitensis* Rathbun described from the Thomonde formation (lower Miocene) of Haiti are common at U.S.G.S. sta. 13732 at the southern end of the dam. The determinations were made by Miss Mary J. Rathbun. They indicate an age as old if not older than the Guajalote.

#### U. S. GEOLOGICAL SURVEY STATION NUMBERS

Northeastern Mexico is arid and unfertile. The few inhabitants live on scattered ranches, and the place names mean very little to those unfamiliar with the terrane. For that reason, an attempt has been made to relate the localities from which collec-



tions have been made to a gridded map, and in the majority of text citations, the field description of the locality can be found only by reference to the succeeding list of Station numbers.

- 13139. East bank, Rio San Juan at La Ermita de Abajo, China, Nuevo León. E-18.
- 13140. Arroyo La Ermita at crossing of main road from La Ermita de Abajo to La Arena, China, Nuevo León. E-18.
- 13228. 12 kilometers southwest of International Bridge in banks of Rio Salado, Guerrero, Tamaulipas. (North of area shown on map.)
- 13262. 7 kilometers southwest of Estación Aldamas, Los Aldamas, Nuevo León. F-11.
- 13450. 4.5 kilometers south of La Alameda, 520 meters southeast of crossing of east-west brecha, China, Nuevo León. D-19.
- 13454. 4.5 kilometers west-southwest of Rancho Palma, Carlos Cantú, General Bravo, Nuevo León. H-15.
- 13455. 3950 meters N.  $24\frac{1}{2}^{\circ}$  W. from church tower in San Fernando, San Fernando, Tamaulipas. W-29.
- 13458. Juan de Benavides tract, about 50 meters north of station 125, Cerralvo, Nuevo León. B-10.
- 13459. 5.5 kilometers south-southeast of Agualeguas, near Loma Comales, Agualeguas, Nuevo León. B-6.
- 13460. Cuevas Ridge, 4 kilometers northwest of Juarez, Cerralvo, Nuevo León. B-7.
- 13461. Arroyo west of road to Guatempo, Rancho San Andreas, 4 kilometers north of Las Burras, Mier, Tamaulipas. D-4.
- 13462. Downstream section of tilted shales on Rio San Juan, a few meters to the west of and stratigraphically below U.S.G.S. sta. 13485, China, Nuevo León. E-18.
- 13463. Top of fucoidal sandstone 7600 meters east of old church at Cerralvo, Cerralvo, Nuevo León. B-9.
- 13464. Nicolas Garcia hacienda, 7 kilometers east of old church in Cerralvo, Cerralvo, Nuevo León. B-9.
- 13465. 7200 meters S.  $44^{\circ}$  W. from church tower in Mier, Mier, Tamaulipas. G-4.
- 13466. 4 kilometers north of Los Herreras, Los Herreras, Nuevo León. D-11.
- 13467. In arroyo 1.5 kilometers east-northeast of Rancho La Rosita, Zacate, General Bravo, Nuevo León. M-11.
- 13468. 4 kilometers east-northeast of Cerralvo, Cerralvo, Nuevo León. A-9.
- 13469. 5 kilometers east-northeast of Cerralvo, Cerralvo, Nuevo León. A-9.
- 13470. Chapa hacienda, 11 kilometers east-northeast of Cerralvo, Cerralvo, Nuevo León. B-9.
- 13471. Chapa hacienda, 9.5 kilometers east-northeast of Cerralvo, Cerralvo, Nuevo León. B-9.
- 13472. 4.5 kilometers northwest of General Treviño and north of the Chapa well, General Treviño, Nuevo León. B-6.
- 13473. 5.5 kilometers south-southeast of Agualeguas, Agualeguas, Nuevo León. B-6.
- 13474. 7 kilometers (air line) south-southeast of Agualeguas, General Treviño, Nuevo León. B-6.
- 13475. 1.5 kilometers east of Queriza on the Cerralvo-Mier road, Mier, Tamaulipas. E-5.
- 13476. 2.4 kilometers east of Queriza on the Cerralvo-Mier road, Mier, Tamaulipas. E-4.
- 13477. 1 kilometer northeast of the Santo Domingo ranch house on the Cerralvo-Mier road, Mier, Tamaulipas. F-4.
- 13478. 800 meters east of the conglomerate at the top of the Carrizo on the Cerralvo-Mier road, Mier, Tamaulipas. F-4.
- 13479. On the Cerralvo road, 15.7 kilometers west of Mier, Mier, Tamaulipas. F-4.
- 13480. On the Cerralvo road, 14.9 kilometers west of Mier, Mier, Tamaulipas. F-4.
- 13481. 11 kilometers (air line) southwest of Mier, on main road to Cerralvo, Mier, Tamaulipas. G-4.
- 13482. 0.5 kilometer north of Rio San Antonio on La Palma-Los Aldamas road and a little less than a kilometer southwest of the Pedro Peña ranch house on the General Treviño-Los Aldamas road; Los Aldamas, Nuevo León. F-9.



13483. A little less than 1 kilometer above the mouth of Arroyo La Cruz, Los Aldamas, Nuevo León. H-9.
13484. La Laja, Los Herreras, Nuevo León. E-12.
13485. Downstream section of tilted shales on Rio San Juan; highest of the three outcrops from which collections were taken but below the series of evenly stratified and barren shales; China, Nuevo León. E-18.
13486. Downstream section of tilted shales on Rio San Juan, the most western and stratigraphically the lowest outcrop in the section; China, Nuevo León. E-18.
13487. East of the major fault in the upstream section on Rio San Juan, China, Nuevo León. D-18.
13488. Upthrow side of fault in upstream section of Rio San Juan, China, Nuevo León. D-18.
13489. 4 kilometers (air line) east of Rancho La Alameda, Rio San Juan, China, Nuevo León. D-18.
13490. 4 kilometers west of Rancho Altamira, Coyote Concession, China, Nuevo León. D-18.
13491. 4 kilometers west of Rancho Altamira, Coyote Concession, China, Nuevo León. D-18.
13492. 4 kilometers north-northeast of Rancho La Alameda, Coyote Concession, China, Nuevo León. D-18.
13493. 2430 meters S.  $36\frac{1}{2}^{\circ}$  E. of church tower in Mier, Mier, Tamaulipas. H-4.
13494. 2300 meters N.  $48\frac{1}{2}^{\circ}$  E. of church tower in Mier, Mier, Tamaulipas. H-3.
13495. 2620 meters N.  $37\frac{1}{2}^{\circ}$  E. of church tower in Mier, Mier, Tamaulipas. H-3.
13496. 8770 meters S.  $37\frac{1}{2}^{\circ}$  E. of church tower in Mier, Mier, Tamaulipas. I-4.
13497. 9330 meters S.  $43\frac{1}{2}^{\circ}$  E. of church tower in Mier, Mier, Tamaulipas. I-4.
13498. 12.5 kilometers S.  $41\frac{1}{2}^{\circ}$  E. of Mier church tower in Mier, Mier, Tamaulipas. I-5.
13499. Rio Grande, 8150 meters southeast of church tower, in Mier, Mier, Tamaulipas. I-4.
13500. Mexican bank of Rio Grande 150 meters below U.S.G.S. sta. 13499, Mier, Tamaulipas. I-4.
13501. Rancho Placeta, 12.5 kilometers southeast of Mier, Mier, Tamaulipas. I-5.
13502. 14 kilometers S.  $26^{\circ}$  E. of Ciudad Camargo, Camargo, Tamaulipas. N-7.
13503. 20.8 kilometers S.  $12^{\circ} 30'$  E. of Ciudad Camargo, Camargo, Tamaulipas. N-8.
13504. 15.9 kilometers S.  $7^{\circ} 30'$  E. of Ciudad Camargo, Camargo, Tamaulipas. M-8.
13505. 21 kilometers S.  $25^{\circ} 30'$  E. of Ciudad Camargo, Camargo, Tamaulipas. N-8.
13506. 13.5 kilometers S.  $12^{\circ}$  E. of Ciudad Camargo, Camargo, Tamaulipas. M-7.
13507. About 5 kilometers south of El Azucar, Camargo district, Camargo, Tamaulipas. M-7.
13508. One kilometer north of Nuevo Camargo, La Mision, Camargo, Tamaulipas. M-5 and M-6.
13509. In arroyo 762 meters south and 610 meters east of Rancho La Copa, Zacate, General Bravo, Nuevo León. M-11.
13510. In arroyo 1035 meters south and 305 meters east of Rancho La Copa, Zacate, General Bravo, Nuevo León. M-11.
13511. Arroyo between Rio Panorama and Rancho La Copa, 100 meters above road crossing, Zacate, General Bravo, Nuevo León. M-11.
13513. Arroyo 411 meters north and 762 meters west of Rio Panorama, Zacate, General Bravo, Nuevo León. M-11.
13514. Old road from La Coma to General Bravo, S.  $15^{\circ}$  E. of Kilometer 151 on Reynosa-Monterrey highway, Zacate, General Bravo, Nuevo León. M-13.
13515. East side of field at triangulation point Cuervito No. 2, Zacate, General Bravo, Nuevo León. M-12.
13516. In large arroyo just above crossing of old road from Rancho Cuervito to Rancho Llanitos, Zacate, General Bravo, Nuevo León. M-12.
13517. At and just west of Rancho Paulino Rios, General Bravo, Nuevo León. N-15.
13518. In old field where road from Rancho El Amole to Rancho Esperanza crosses arroyo, General Bravo, Nuevo León. N-10.
13519. East slope of hill east of Rancho Esperanza on road to Rancho El Amole, General Bravo, Nuevo León. M-10.
13520. 743 meters west and 426 meters south of M-62 measured on state line, General Bravo, Nuevo León. N-10.



13521. 1.5 kilometers east of Rancho La Copa, General Bravo, Nuevo León. M-10.
13522. In large arroyo at old road crossing just north of Rancho Llanitos, General Bravo, Nuevo León. M-11.
13523. In arroyo flowing northward into Arroyo San Antonio 914 meters east and 335 meters north of triangulation point Davila; General Bravo, Nuevo León. M-12.
13524. In arroyo San Antonio, 1.5 kilometers west-southwest of Rancho Llanitos; 2149 meters west and 107 meters south of triangulation point Llanitos; General Bravo, Nuevo León. M-11.
13527. In Arroyo San Antonio, 1676 meters west-southwest of Rancho Llanitos, General Bravo, Nuevo León. M-11.
13528. In fork of Arroyo Lobo, 1500 meters S. 45° E. of Rancho Minillas, Carlos Cantú, General Bravo, Nuevo León. I-14.
13529. In small arroyo on road to Rancho Max Rodriguez, 500 meters east of Rancho El Rucio, General Bravo, Nuevo León. M-11.
13530. In deep arroyo on old road from La Coma to Puerta Rosa, 305 meters west of triangulation point Puerta Rosa No. 1; Zacate, General Bravo, Nuevo León. O-13.
13531. Top of hill 1219 meters south of old road from Rancho La Coma to Majarras, 731 meters southeast of triangulation point Tuna; Zacate, General Bravo, Nuevo León. M-13.
13532. On old road 397 meters south-southwest of Rancho Laguna de los Indios, Ojito de Agua, China, Nuevo León. O-19.
13533. At northwest corner of main square Rancho Laguna de Los Indios, China, Nuevo León. O-19.
13534. On old China-Matamoras road just west of triangulation point La Hosca, China, Nuevo León. O-17.
13535. 458 meters southwest of Rancho Miralejas, Carlos Cantú, General Bravo, Nuevo León. N-17.
13536. On road from El Prieto to Rancheria, 1066 meters northeast of Rancheria, China, Nuevo León. M-18.
13537. West slope of high hill at abandoned Topo ranch, 1005 meters southwest of triangulation point Topo 2, Zacate, General Bravo, Nuevo León. M-14.
13538. Southeast side of Arujo ranch house, Zacate, General Bravo, Nuevo León. L-11.
13539. East slope of hill on old road which crosses Miralejas-Cojita road 1829 meters south of Rancho Miralejas, Carlos Cantú, China, Nuevo León. N-17.
13540. On road from Rancho Arujo to La Canela, 1500 meters west from Rancho Arujo, General Bravo, Nuevo León. K-11.
13541. 670 meters south of Reynosa-Monterrey highway measured from a point 1500 meters east of point where continental highway enters from the north; General Bravo, Nuevo León. J-13.
13542. In small arroyo just north of road crossing and 240 meters N. 15° W. from Continental Core drill hole Z-2, Hacienda Naranjas, Zacate, General Bravo, Nuevo León. J-13.
13543. On old road which crosses continental highway 1000 meters south of Arroyo Viboritas and 100 meters east of highway; Zacate, General Bravo, Nuevo León. J-14.
13544. 50 meters north of Continental Core drill hole C. C. 18, General Bravo, Nuevo León. J-15.
13545. 150 meters east of Rancho Venadito in washed out road, Carlos Cantú, General Bravo, Nuevo León. J-15.
13546. In Arroyo Tomatito, 150 meters north of Monterrey-Reynosa highway and 2250 meters east of triangulation point Banquette; Carlos Cantú, General Bravo, Nuevo León. I-14.
13547. 300 meters south of Monterrey-Reynosa highway on old road 1050 meters S. 57° E., from triangulation point Banquette; General Bravo, Nuevo León. I-14.
13548. North of Monterrey-Reynosa Highway, 2.4 kilometers west-northwest of Rancho Banquette, 3.02 meters S. 70° E. from triangulation point Banquette; Carlos Cantú, General Bravo, Nuevo León. H-14.
13549. In main bend of Rio San Juan south of La Ermita de Abajo, China, Nuevo León. E-18.
13550. Upstream section west of major fault, Rio San Juan, China, Nuevo León. D-18.



13551. On road from Rancho Tinaja de Vaca to Oscurito, 1200 meters west-southwest of Rancho Tinaja de Vaca, Carlos Cantú, General Bravo, Nuevo León. H-15.
13552. In small arroyo 500 meters northeast of Rancho Cabeza del Toro, Carlos Cantú, China, Nuevo León. I-16.
13553. On road to General Bravo, 2.7 kilometers west of Rancho Parada, Carlos Cantú, General Bravo, Nuevo León. H-15.
13554. On southeast slope of low hill 1 kilometer east of triangulation point Palma, Carlos Cantú, General Bravo, Nuevo León. I-14.
13555. 7 kilometers east of General Bravo, on road to Rancho Minutas; Carlos Cantú, General Bravo, Nuevo León. H-14.
13556. 9 kilometers southeast of General Bravo, on road to Rancho Minutas; Carlos Cantú, General Bravo, Nuevo León. I-14.
13557. 625 meters S. 5° E. of triangulation point Celsa, west side of road from Ebanito to Doctor Cos, 3200 meters S. 60° E. of Estación Aldamas; Zacate, Doctor Cos, Nuevo León. H-10.
13558. 250 meters southwest of Bench Mark Salinas, 2150 meters east-northeast of Doctor Cos; Zacate, Doctor Cos, Nuevo León. H-12.
13559. In arroyo 250 meters south-southwest of Bench Mark Salinas, 2300 meters east-northeast of Doctor Cos, Zacate, Doctor Cos, Nuevo León. H-12.
13560. 2350 meters east of Doctor Cos on road to Loma Guajardo, Zacate, Doctor Cos, Nuevo León. H-12.
13561. 2125 meters east of Doctor Cos, on road to Loma Guajardo, Zacate, Doctor Cos, Nuevo León. H-12.
13562. 2050 meters east of Doctor Cos on road to Loma Guajardo, Zacate, Doctor Cos, Nuevo León. H-12.
13563. West side of low ridge 2800 meters S. 55° E. of Doctor Cos, Carlos Cantú, Doctor Cos, Nuevo León. H-12.
13564. 50 meters east-northeast of U.S.G.S. sta. 13563, Zacate, Doctor Cos, Nuevo León. H-12.
13565. On west side of road to Loma Guajardo, 4750 meters S. 74° E. of Doctor Cos, Zacate, Doctor Cos, Nuevo León. H-12.
13566. On road 5775 meters S. 68° E. of Doctor Cos, Zacate, Doctor Cos, Nuevo León. H-12.
13567. 350 meters south of Bench Mark Chamacuero, Doctor Cos, Nuevo León. H-11.
13568. 3.2 kilometers N. 23° E. of Doctor Cos, Zacate, Doctor Cos, Nuevo León. G-11.
13569. 1.4 kilometers N. 7½° W. of Bench Mark Chata, General Bravo, Nuevo León. H-12.
13570. 0.8 kilometer N. 10° E. of Bench Mark Chata, General Bravo, Nuevo León. H-12.
13572. At dam, west end of La Llorona, Reynosa, Tamaulipas. T-16.
13573. At main scarp halfway from Las Anacuas to Santa Cruz on old road; San Fernando, Tamaulipas. U-23.
13574. On main scarp halfway from Las Anacuas to Santa Cruz, just north of old San Fernando road, Tamaulipas. U-23.
13576. Downstream along Rio Conchos, 12.6 kilometers S. 70° E. from Mendez, San Fernando, Tamaulipas. R-26.
13577. Downstream along Rio Conchos, 12.6 kilometers S. 70° E. from Mendez, San Fernando, Tamaulipas. R-26.
13578. 2300 meters S. 27° W. from Rancho Guajalote, San Fernando, Tamaulipas. U-25.
13579. 5 kilometers N. 21° W. of Mendez, San Fernando, Tamaulipas. P-25.
13581. 2600 meters S. 50° E. from Rancho Gigante, San Fernando, Tamaulipas. P-25.
13582. Exposure in road, 2600 meters S. 42° E. from Rancho El Tigre; Mendez, San Fernando, Tamaulipas. O-25.
13583. About 9 kilometers due south of Mendez, San Fernando, Tamaulipas. P-27.
13584. 8500 meters N. 42° W. from San Fernando, San Fernando, Tamaulipas. V-29.
13585. 8600 meters N. 40° W. from San Fernando, San Fernando, Tamaulipas. V-29.
13586. 11,500 meters N. 30° W. from San Fernando, San Fernando, Tamaulipas. V-29.
13587. Due south 3250 meters from church tower in San Fernando, San Fernando, Tamaulipas. W-30.



13588. 620 meters N. 55° W. from church tower in San Fernando, San Fernando, Tamaulipas. W-30.
13589. 3737 meters south from Rancho El Mantillo on road to Presa Nueva, Carlos Cantú, China, Nuevo León. L-23.
13590. 2.4 kilometers S. 55° E. from Bench Mark Chata, Carlos Cantú, General Bravo, Nuevo León. I-13.
13591. 2 kilometers W. 15° S. from triangulation point Ceniza, Carlos Cantú, General Bravo, Nuevo León. H-13.
13592. 1.2 kilometers S. 50° W. from triangulation point Ceniza, Carlos Cantú, General Bravo, Nuevo León. I-13.
13593. 1.1 kilometers S. 47° W. from triangulation point Ceniza, Carlos Cantú, General Bravo, Nuevo León. I-13.
13594. 2.4 kilometers W. 4° S. from triangulation point Ceniza, Carlos Cantú, General Bravo, Nuevo León. H-13.
13595. 10.5 kilometers east of China, Carlos Cantú, China, Nuevo León. H-15.
13596. 8 kilometers E. 35° N. of China, Carlos Cantú, China, Nuevo León. H-15.
13597. Old road just east of Realitos corrals, Carlos Cantú, China, Nuevo León. I-18.
13598. Presa El Mescal, Zacate, General Bravo, Nuevo León. L-11.
13599. 11.5 kilometers E. 6° N. of China, Carlos Cantú, General Bravo, Nuevo León. H-15.
13600. In Arroyo Agua Fria, 5.7 kilometers S. 23° E. of General Bravo, Carlos Cantú, General Bravo, Nuevo León. H-15.
13601. 4.2 kilometers west of Rancho Topito, Carlos Cantú, China, Nuevo León. H-16.
13602. 3.5 kilometers W. 12° S. of Rancho Lajita, Carlos Cantú, China, Nuevo León. H-16.
13603. 7.5 kilometers east of China, Carlos Cantú, China, Nuevo León. H-15.
13604. In Arroyo La Laja, 4 kilometers E. 17° S. of China, Carlos Cantú, China, Nuevo León. G-16.
13605. Juan de Benavides tract, about 50 meters north of Station 125, Cerralvo district, Nuevo León. B-10.
13606. 8 kilometers E. 20° S. from Cerralvo, Cerralvo, Nuevo León. B-9.
13608. On north flank of hill 100 meters northeast of State line Monument Virola, San Fernando, Tamaulipas. S-20.
13609. About 100 meters southwest of Agualeguas-General Treviño road, 1.5 kilometers east-southeast of Agualeguas, Agualeguas, Nuevo León. B-5.
13617. 3 kilometers north-northwest of Rancho Charco de Piedra, Carlos Cantú, China, Nuevo León. H-18.
13618. 1320 meters S. 70° W. of Rancho Pablo Rodriguez, Carlos Cantú, China, Nuevo León. H-17.
13619. 1 kilometer south of Rancho Cantú, Carlos Cantú, China, Nuevo León. H-17.
13620. On west side of gravel scarp north of Rancho El Hueso, about 300 meters west of road from El Hueso to Amarillas; Carlos Cantú, China, Nuevo León. L-23.
13621. North of El Hueso, 750 meters southeast of triangulation station Ceniza, 250 meters east of road from El Hueso to Amarillas; Carlos Cantú, China, Nuevo León. L-23.
13622. On prominent rounded hill east side of road from Rancho Presa Nueva to El Hueso, Carlos Cantú, China, Nuevo León. L-23.
13623. In arroyo at Rancho Presa Nueva-Mantillo road crossing, Carlos Cantú, Nuevo León. L-24.
13625. On hill slope 2100 meters northwest of Rancho Potrero on east side of road to Guitana, Carlos Cantú, China, Nuevo León. J-20.
13626. Exposures on road from Rancho Presa Nueva to Las Estacas northeast of Rancho Presa Nueva, Santa Ana, China, Nuevo León. L-24.
13627. About 2200 meters southeast from Rancho Presa Nueva on road to Las Estacas; Santa Ana, China, Nuevo León. L-24.
13628. South end of sandstone ridge about 2750 meters southeast of Rancho Presa Nueva, Santa Ana, China, Nuevo León. L-24.



13629. On east side of road from Rancho Presa Nueva to Las Estacas, about 2400 meters southeast of Rancho Presa Nueva; China, Nuevo León. L-24.
13630. Exposures along north edge of gravel scarp near Tamaulipas-Nuevo León state line and about 1 kilometer east of road from Rancho Presa Nueva to Rancho Las Estacas; Santa Ana, China, Nuevo León. M-25.
13631. Exposures on south edge of gravel scarp near Tamaulipas-Nuevo León state line and about 1 kilometer east of road from Rancho Presa Nueva to Rancho Las Estacas; Santa Ana, China, Nuevo León. M-25.
13632. 2100 meters southeast of Rancho Presa Nueva, Santa Ana, China, Nuevo León. L-24.
13633. On west slope of hill in old road from El Mantillo to Rancho Las Estacas, 2150 meters northeast of Rancho Presa Nueva; Santa Ana, China, Nuevo León. L-24.
13634. On south side of open plain, 4500 meters southeast of Rancho Presa Nueva, Santa Ana, China, Nuevo León. M-24.
13635. 6150 meters northwest of Rancho Las Estacas, on road from Rancho Presa Nueva; Santa Ana, China, Nuevo León. M-24.
13636. On old road 1640 meters east of triangulation point Llano, Santa Ana, China, Nuevo León. M-24.
13637. West slope of ridge 900 meters north-northwest of triangulation point Rincon, Santa Ana, China, Nuevo León. M-24.
13638. On east slope of ridge 4070 meters east of triangulation point Apuro, Santa Ana, China, Nuevo León. M-24.
13639. On east slope of ridge 130 meters east of Rancho El Prieto, San Fernando, Tamaulipas. M-25.
13640. 630 meters north of Rancho El Prieto, San Fernando, Tamaulipas. M-25.
13641. 1000 meters north of Rancho El Prieto on south slope of ridge, San Fernando, Tamaulipas. M-25.
13642. 1620 meters west of triangulation point Capa, 2250 meters northwest of Rancho El Prieto; Santa Ana, China, Nuevo León. M-25.
13643. 300 meters west of triangulation point Capa, 2150 meters northwest of Rancho Barretosa, 2700 meters northeast of Rancho El Prieto; San Fernando, Tamaulipas. M-25.
13644. Exposure in arroyo Barretosa, 800 meters southwest of triangulation point Capa, 2100 meters northeast of Rancho El Prieto, 1800 meters northwest of Rancho Barretosa; Santa Ana, San Fernando, Tamaulipas. M-25.
13645. 950 meters southwest of triangulation point Capa, 2000 meters northeast of Rancho El Prieto, 1950 meters northwest of Rancho Barretosa; Santa Ana, San Fernando, Tamaulipas. M-25.
13646. 500 meters S.  $34^{\circ}$  W. from church tower in Mier, Mier, Tamaulipas. H-3.
13647. In Zaragoza-San Antonio road,  $6\frac{1}{2}$  kilometers N.  $12^{\circ}$  E. from Rancho San Antonio de la Luz, China, Nuevo León. E-18.
13649. Section east of mouth of Arroyo Mohinas, Rio San Juan, China, Nuevo León. E-18.
13650. South bank Rio San Juan opposite Rancho Viejo, China, Nuevo León. D-18.
13651. South bank Rio San Juan opposite Rancho Viejo, China, Nuevo León. D-18.
13652. South bank Rio San Juan opposite Rancho Viejo, China, Nuevo León. D-18.
13653. Loma Prieta in east-west brecha, 11.5 kilometers W.  $10^{\circ}$  N. from La Ermita de Abajo; China, Nuevo León. C-17.
13654. Loma Chapeño, 8 kilometers W.  $15^{\circ}$  N. of La Ermita de Abajo, China, Nuevo León. D-17.
13655. West end of Loma Chapeño, 8 kilometers W.  $15^{\circ}$  N. of La Ermita de Abajo, China, Nuevo León. D-17.
13657. 1.6 kilometers east of Agualeguas on the San Javier road, Agualeguas, Nuevo León. B-5.
13658. 2.1 kilometers from intersection of Arroyo Lobo and San Agustin-Santa Monica road; China, Nuevo León. E-12.
13659. On Santa Monica road, 4.59 kilometers from intersection of Arroyo Lobo and San Agustin-China road; China, Nuevo León. E-13.



13660. West flank of Alto Colorado on Estación Aldamas-Herrerias road, Los Aldamas, Nuevo León. F-11.
13661. Intersection of property line 11-12 and Camino Real 9.2 kilometers west of Los Aldamas, Los Aldamas, Nuevo León. F-9.
13663. Near old ranch about 6.4 kilometers N. 52° W. of Los Aldamas, Los Aldamas, Nuevo León. F-9.
13664. 1.1 kilometers north of La Palmita in arroyo on right side of road, Los Aldamas, Nuevo León. E-12.
13665. About 1 kilometer west from railroad on road to Rancho La Sandilla, Los Aldamas, Nuevo León. E-11.
13667. Top of small hill just north of La Laja, Los Herreras, Nuevo León. E-12.
13668. Hill just north of La Laja, Los Herreras, Nuevo León. E-12.
13669. Second field on road north of La Laja, Los Herreras, Nuevo León. E-12.
13670. 2.5 kilometers northeast of Rancho La Ceja on Carrizo Ridge, Los Aldamas, Nuevo León. E-11.
13671. Near southwest end of presa on El Puerta-Canadá del Agua road, Los Aldamas, Nuevo León. E-10.
13672. Southeast corner of Lot 16-1, Los Aldamas, Nuevo León. E-10.
13673. 1.5 kilometers south of northeast corner of Lot 14, Los Aldamas, Nuevo León. E-9.
13675. 1.5 kilometers southwest of northeast corner of Lot 13, Los Aldamas, Nuevo León. E-9.
13676. 1.5 kilometers southwest of the northeast corner of Lot 13, Los Aldamas, Nuevo León. E-9.
13677. In Arroyo San Antonio near Santa Cruz, Los Aldamas, Nuevo León. F-8.
13678. On southwest side of Arroyo San Antonio in Lot 19, Los Aldamas, Nuevo León. F-9.
13679. 1.5 kilometers north of La Laja, Los Herreras, Nuevo León. E-11.
13680. 1 kilometer south of El Sabinito, Los Aldamas, Nuevo León. G-11.
13681. 0.5 kilometer southwest of Rancho Blanco, Los Aldamas, Nuevo León. E-9.
13682. 1 kilometer west of Rancho La Hozca, Los Aldamas, Nuevo León. F-8.
13683. 2 kilometers northwest of southeast corner of Lot 20 near Los Aldamas, Los Aldamas, Nuevo León. E-9.
13684. 1 kilometer north of Rancho Buena Vista, Los Aldamas, Nuevo León. F-7.
13685. Rio San Juan, 1.5 kilometers east of El Barrio, Los Aldamas, Nuevo León. H-9.
13686. 1 kilometer north of El Barrio, Los Aldamas, Nuevo León. G-9.
13687. 1.5 kilometers west of La Laja, Los Herreras, Nuevo León. D-12.
13688. 0.25 kilometer west of Rancho El Abrita on road to Herreras, Los Aldamas, Nuevo León. G-11.
13689. 250 meters south of brecha crossing in Arroyo Santo Domingo, Mier, Tamaulipas. E-5.
13690. 75 meters north of brecha crossing in Arroyo Santo Domingo, Mier, Tamaulipas. E-5.
13691. 3 kilometers north of brecha crossing in Arroyo Santo Domingo, Mier, Tamaulipas. F-5.
13692. 375 meters northeast of Rancho Puerto Maguey, Mier, Tamaulipas. F-5.
13693. 3.5 kilometers east of Tamaulipas-Nuevo León state line on pipe line brecha; Mier, Tamaulipas. F-5.
13694. 1 kilometer N. 48° W. of Kilometer 124 on pipe line brecha; Mier, Tamaulipas. E-5.
13695. In arroyo, 0.5 kilometer west of Kilometer 124 on pipe line brecha; Mier, Tamaulipas. E-6.
13696. 0.5 kilometer east of Rio Agualeguas on north side of river, a little below the Agualeguas-General Treviño canton line; General Treviño, Nuevo León. C-6.
13699. 3 kilometers west of San Javier on road to Agualeguas, General Treviño, Nuevo León. C-6.
13700. 1.5 kilometers west of San Javier, 0.25 kilometer south of Agualeguas road, General Treviño, Nuevo León. C-6.
13701. 1087 meters east of Tamaulipas-Nuevo León state line on pipe line brecha, Mier, Tamaulipas. F-5.
13702. 3 kilometers east of Tamaulipas-Nuevo León state line on pipe line brecha, Mier, Tamaulipas. F-5.
13703. 1.25 kilometers northeast of Rancho Arbolitos, Mier, Tamaulipas. F-6.



13704. 1.5 kilometers northeast of Rancho Arbolitos, Mier, Tamaulipas. F-6.
13705. 1.25 kilometers S. 50° W. of Kilometer 127 on pipe line brecha west of Tanquecito; Mier, Tamaulipas. F-5.
13706. 2 kilometers north of railroad and 700 meters west of road from Los Aldamas to La Sandilla, Los Aldamas, Nuevo León. E-11.
13707. West base of small hill just north of La Laja, Los Herreras, Nuevo León. E-12.
13708. Collection discarded. G-13.
13711. Rio Alamo at mouth of Arroyo Huatempo, Mier, Tamaulipas. E-4.
13713. Rio Alamo just south of Las Auras, Mier, Tamaulipas. E-4.
13714. West flank of Mesa Llano, Mier, Tamaulipas. E-4.
13715. Just west of triangulation point Tuna, Mier, Tamaulipas. E-4.
13716. East flank of hill, triangulation point Tuna, Mier, Tamaulipas. E-4.
13717. East of triangulation point Tuna, Mier, Tamaulipas. E-4.
13718. East of triangulation point Tuna, Mier, Tamaulipas. E-4.
13719. East of triangulation point Tuna, Mier, Tamaulipas. E-4.
13720. East of triangulation point Tuna, Mier, Tamaulipas. E-4.
13721. 440 meters west of triangulation point Nopal, Mier, Tamaulipas. E-3.
13722. Near east bank of Arroyo del Huizachal, 8800 meters east from the intersection of the Alamo River and the Tamaulipas-Nuevo León state line; Mier, Tamaulipas. E-3.
13723. 850 meters northeast of triangulation point La Palma, Mier, Tamaulipas. E-3.
13724. West bank of Arroyo del Huizachal, 5700 meters N. 71° E. from the intersection of the Alamo River and Tamaulipas-Nuevo León state line; Mier, Tamaulipas. E-3.
13725. 1850 meters northwest of triangulation point Paraiso, Mier, Tamaulipas. E-3.
13726. Along brecha, 650 meters south of northwest corner of Lot 4, Mier, Tamaulipas. D-1.
13727. Intersection of Arroyo del Huizachal and Nuevo León-Tamaulipas state line, Mier, Tamaulipas. D-2.
13728. Along brecha, 2630 meters east of northeast corner of Lot 4, Mier, Tamaulipas. E-1.
13730. 2050 meters west of Paraiso, Mier, Tamaulipas. E-3.
13731. Near east bank of Arroyo del Huizachal, on west flank of hill, triangulation point Chata, Mier, Tamaulipas. E-3.
13732. At south end of La Llorona dam, 10 meters west of Campo Llorona, Hacienda Rio Bravo, Reynosa, Tamaulipas. T-16.
13733. Rio San Juan, 400 meters below mouth of Arroyo San Antonio, Mier, Tamaulipas. J-7.
13734. Rio San Juan, about 700 meters down stream from mouth of Arroyo San Antonio; Ochoa, Camargo, Tamaulipas. J-7 and K-7.
13735. West face of prominent escarpment just east of Rancho La Reforma, La Reforma, Camargo, Tamaulipas. K-7.
13736. From well dug at Rancho El Quitrin, Mier, Tamaulipas. J-6.
13737. South wall of Rio San Juan at Paso Comales below prominent hill with white monument, Ochoa, Camargo, Tamaulipas. K-7.
13738. West side of old road to Roma, Texas, about 1.5 kilometers northeast of Rancho San Antonio, Mier, Tamaulipas. J-6.
13739. Arroyo about 200 meters west-southwest of Station 286 near base of yellowish selenitic clay series; Ochoa, Camargo, Tamaulipas. K-7.
13740. Telephone pole, Station 331-0, Ochoa, Camargo, Tamaulipas. K-8.
13741. Rio San Juan below triangulation point Loma Pescada, Ochoa, Camargo, Tamaulipas. K-7.
13742. Rio Alamo, about 500 meters downstream from Las Auras, Mier, Tamaulipas. E-4.
13743. Arroyo on Mier-Roma road about 5 kilometers southeast of Mier, Mier, Tamaulipas. I-4.
13744. Arroyo about 1 kilometer east of La Barranca, Malahueco, Mier, Tamaulipas. E-3.
13745. 500 meters south of Paso del Pedernal below first waterfall on Rio San Juan, Mier, Tamaulipas. J-8.
13746. East hill slope about 2.6 kilometers north of Mier-Parás road; about 6.5 kilometers east of crossing of Rio Alamo and the Nuevo León-Tamaulipas state line; Mier, Tamaulipas. E-3.



- 13747. Near Rio San Juan, in bottom of deep arroyo about 500 meters north of Loma Pescada, Camargo, Tamaulipas. K-7.
- 13748. Rio San Juan at mouth of Arroyo del Cerrito, Camargo, Tamaulipas. K-7.
- 13749. Arroyo about 100 meters east of La Pescada-Camargo road, about 2.7 kilometers from La Pescada, Camargo, Tamaulipas. K-7.
- 13750. West of El Quitrin ranch house, Mier, Tamaulipas. J-6.
- 13751. Arroyo on north side of road about 1 kilometer northeast of Rancho Haciendita, Mier, Tamaulipas. K-6.
- 13752. Near base of escarpment about 200 meters north of La Reforma, Camargo, Tamaulipas. K-7.
- 13753. Near top of escarpment 1 kilometer north of La Reforma and 1 kilometer south of El Sauzito, Camargo, Tamaulipas. K-7.
- 13754. West side of escarpment below Loma del Azucar, Camargo, Tamaulipas. M-7.
- 13755. Monterrey-Matamoros highway, 10 kilometers west of Paso de la Loma, China, Nuevo León. E-15.
- 13756. Monterrey-Matamoros highway, 10.5 kilometers west of Paso de la Loma, China, Nuevo León. E-15.
- 13758. On Rancho Durazno-Encadenado road, 3.5 kilometers northeast of Encadenado, China, Nuevo León. B-19.
- 13759. Black calcite oyster zone with glauconite on El Porvenir-Encadenado road, 800 meters north from Encadenado, China, Nuevo León. B-20.
- 13760. Small arroyo 300 meters west of Rancho Rincon and 110 meters downstream from Camino Real, China, Nuevo León. D-19.
- 13761. 170 meters N. 37° W. from Rancho Viejo, China, Nuevo León. D-18.
- 13764. S. 35° E. brecha 180 meters from road west from La Ermita de Abajo, China, Nuevo León. D-18.
- 13765. 650 meters N. 70° E. from Rancho Viejo, China, Nuevo León. E-18.
- 13766. On top and on north flank of Punta Cerrito, 6 kilometers S. 70° W. from church tower in Mier, Mier, Tamaulipas. G-4.
- 13767. 900 meters S. 45° E. from Punta Cerrito in Arroyo Cerrito, Mier, Tamaulipas. G-3.
- 13768. Downstream, from crossing of south boundary of Lot 6 and Arroyo Cerrito; Mier, Tamaulipas. G-3.
- 13769. North bank of Rio Alamo at crossing of westerly of the 2 roads from Mier to Guerrero; Mier, Tamaulipas. G-3.
- 13771. 60 meters north of Monument 2, Lot 6, in arroyo crossing brecha; Mier, Tamaulipas. H-3.
- 13772. 5780 meters N. 44° W. from church tower in Mier, Mier, Tamaulipas. G-3.
- 13773. In 3-4 brecha of Lot 6, 1740 meters from Monument 3, Mier, Tamaulipas. H-3.
- 13790. 10 kilometers (air line) southwest of Mier on main road from Mier to Cerralvo; Mier, Tamaulipas. G-4.
- 13800. 100 meters S. 70° E. from Rancho Los Magueyes and 5940 meters N. 30° W. from El Arcabuz on Rio San Juan; Mier, Tamaulipas. H-9.
- 13806. 650 meters N. 75° E. of Punta Nogales, Mier, Tamaulipas. G-2.
- 13807. On west boundary of Lot 6, 1240 meters due north from southwest corner; Mier, Tamaulipas, G-3.
- 13861. In branch of Arroyo Saladito, 240 meters S. 60° E. from where north brecha of Lot 3 crosses pipe line; Mier, Tamaulipas. H-4.
- 13935. On road to Piedra Perdida from Mier-Guerrero road; 1675 meters from Piedra Perdida; Mier, Tamaulipas. H-3.
- 13936. In Arroyo Piedra Perdida, 900 meters S. 85° W. from Punta Piedra Perdida; Mier, Tamaulipas. G-3.
- 13937. 500 meters S. 45° W. from church tower in Mier, Mier, Tamaulipas. H-3.
- 13938. 700 meters S. 34° W. from church tower in Mier, Ejidos, Mier, Tamaulipas. H-3.
- 13939. 500 meters S. 45° W. from church tower in Mier, Mier, Tamaulipas. H-3.
- 13940. 500 meters S. 45° W. from church tower in Mier, Mier, Tamaulipas. H-3.



- 13941. 700 meters S. 34° W. from church tower in Mier, Mier, Tamaulipas. H-3.
- 13942. 500 meters S. 45° W. from church tower in Mier, Mier, Tamaulipas. H-3.
- 13943. 1300 meters N. 80° W. from church tower in Mier, Ejidos, Mier, Tamaulipas. H-3.
- 13944. Arroyo Chalupa, 1885 meters N. 76° W. from church tower in Mier, Mier, Tamaulipas. H-3.
- 13945. 40 meters south of Mier-Parás road, 1400 meters west from Mier, Mier, Tamaulipas. H-3.
- 13946. 1600 meters S. 85° W. from church tower in Mier, Mier, Tamaulipas. H-3.
- 13947. 2000 meters S. 33° W. from church tower in Mier, Mier, Tamaulipas. H-3.
- 13948. Arroyo Las Lajas, 2600 meters S. 43° W. of church tower in Mier, Mier, Tamaulipas. H-3.
- 13951. 1100 meters S. 50° E. from church tower in Mier, Ejidos, Mier, Tamaulipas. H-3.
- 13952. Left bank Rio Alamo, 900 meters S. 50° E. of church tower in Mier, Mier, Tamaulipas. H-3.
- 13953. Left bank Rio Alamo, 900 meters S. 50° E. of church tower in Mier, Mier, Tamaulipas. H-3.
- 13954. Left bank Rio Alamo, 900 meters S. 50° E. of church tower in Mier, Mier, Tamaulipas. H-3.
- 13956. 270 meters N. 35° W. from where north brecha of Lot 3 crosses pipe line brecha, Mier, Tamaulipas. H-4.
- 13957. In S. 30° W. brecha, 1900 meters S. 5° W., from Alto Mesquital, Mier, Tamaulipas. H-5.
- 13958. 1300 meters N. 80° W. from church tower in Mier, Mier, Tamaulipas. H-3.
- 13959. Halfway up range of hills 2000 meters west of Mendez, on Mendez-Linares road, San Fernando, Tamaulipas. P-25.
- 13960. Cap rock on range of hills 2000 meters due west of Mendez, Mendez-Linares road, San Fernando, P-25.
- 13964. Sheet 4, south Mier survey, Mier, Tamaulipas. H-6.
- 13965. Sheet 4, south Mier survey, Mier, Tamaulipas. H-6.
- 13966. 2 kilometers S. 41° W. from Rancho Las Garcias, about 25 kilometers south of Roma, Mier, Tamaulipas. J-7.
- 13967. 3160 meters S. 80° W. from presa at Rancho Los Cerritos, Carlos Cantú, China, Nuevo León. J-20.
- 13968. 2200 meters N. 56° W. from Rancho Medina, Carlos Cantú, China, Neuvo León. I-19.
- 13969. 2540 meters N. 44° W. from Rancho Medina, Carlos Cantú, China, Neuvo León. I-19.
- 13970. 1830 meters S. 15° W. from Rancho Medina, Carlos Cantú, China, Neuvo León. I-19.
- 13971. 2480 meters S. 7° W., from Rancho Medina, Carlos Cantú, China, Nuevo León. I-20.
- 13972. 3220 meters S. 30° W. from Rancho Medina, Carlos Cantú, China, Nuevo León. I-20.
- 13976. In brecha, 3060 meters due south from northeast corner of Lot 3, thence due west 40 meters; Mier, Tamaulipas. H-5.
- 13977. In brecha, 3905 meters due south from northeast corner of Lot 3, Mier, Tamaulipas. H-5.
- 13978. From northeast corner of Lot 3, due south 4200 meters, thence due west 340 meters; Mier, Tamaulipas. H-5.
- 13979. 4230 meters N. 24° W. from La Presa No. 1, Mier, Tamaulipas. H-5.
- 13980. On telegraph line Mier-Cerralvo, 280 meters southwest of main chert conglomerate ridge; Mier, Tamaulipas. G-4.
- 13981. 2890 meters S. 3° E. from La Presa No. 1, Mier, Tamaulipas. H-6.
- 13983. On north boundary of Lot 3, 3340 meters east from northwest boundary; Mier, Tamaulipas G-4.
- 13984. 1940 meters S. 34° E. from La Presa No. 1, Mier, Tamaulipas. H-6.
- 13985. On north boundary of Lot 6, due east 4400 meters from northwest corner of Lot, thence due south 180 meters; Mier, Tamaulipas. G-2.
- 13986. On north boundary of Lot 6, 2840 meters due east from northwest corner of Lot; Mier, Tamaulipas. G-2.
- 13987. At pass of Rio Alamo and Mier-Parás road, Mier, Tamaulipas. H-3.
- 13988. On gas line, 1700 meters N. 17° W. from triangulation point Tanquecito, Mier, Tamaulipas. F-5. (Name misspelled on map.)



13989. 260 meters north of Rancho Panelete and 800 meters south of Mier-Guerrero boundary; Mier, Tamaulipas. F-1.
13990. Rio San Juan at Monument 54, Mier, Tamaulipas. H-9.
13991. 5.25 kilometers south-southwest of Estación Aldamas, Los Aldamas, Nuevo León. G-11.
13992. About 1 kilometer from railroad on road from Los Aldamas to Rancho La Sandilla, Los Aldamas, Nuevo León. E-11.
13993. On old road from Rancho Piedras to Loma Colorado, just north of Tamaulipas-Nuevo León state line, 7300 feet west of Monument 67; Camargo, Tamaulipas. O-10.
13994. 4 kilometers south of Rio Alamo on the Auras-Chicharrones road; Mier, Tamaulipas. E-4.
14009. In ditch on south side of Monterrey-Reynosa highway, 9200 meters west of Rancho La Coma; 11 kilometers S. 30° E. of Point of V in state line; Zacate, General Bravo, Nuevo León. M-13.
14021. Rio Alamo, 140 meters downstream from the crossing of the Tamaulipas-Nuevo León state line; Mier, Tamaulipas. D-3.
14022. Falls in the Rio San Juan, 500 meters upstream from the mouth of Arroyo San Antonio and 2800 meters N. 79° 30' W. from La Pescada; Ochoa, Camargo, Tamaulipas. J-7.
14023. On a high hill 3750 meters S. 68° W. from Zacate well No. 1; Zacate, General Bravo, Nuevo León. N-13.
14025. 30 meters west of Station 286, Ochoa, Camargo, Tamaulipas. K-7.
14026. 100 meters from Rio San Juan near top of west bank of arroyo, 800 meters north of La Pescada well; Mier, Tamaulipas. K-7.
14027. Ochoa, Camargo, Tamaulipas. K-8.
14028. Near conical hill on north bank of Rio Alamo between Malahueco and Las Auras, Mier, Tamaulipas. E-4.
14029. 2.4 kilometers west of mouth of Arroyo de Pujuelas, Agualeguas, Nuevo León. D-3.
14030. 200 meters west of Rancho Santa Teresa, Rio Bravo Lot 1, Reynosa, Tamaulipas. R-10.
14032. 5.1 kilometers N. 21° W. of Mendez, San Fernando, Tamaulipas. P-25.
14033. 2.2 kilometers N. 22° W. of Mendez, San Fernando, Tamaulipas. P-25.
14034. 1.9 kilometers S. 42° W. of Mendez, San Fernando, Tamaulipas. P-25.
14035. 2 kilometers S. 45° W. of Mendez, San Fernando, Tamaulipas. P-26.
14036. 1.8 kilometers S. 35° W. of Mendez, San Fernando, Tamaulipas. P-25.
14037. 700 meters S. 35° E. along brecha on crest of structure; China, Nuevo León. D-19.
14038. About 3500 meters southwest of Rancho El Lobo on the south and west flanks of Loma de los Gringos, Rio Bravo Lot 1; Reynosa, Tamaulipas. R-14.
14039. On old road from El Lobo to Mezquite about 3500 meters from Rancho El Lobo, Rio Bravo Lot 1; Reynosa, Tamaulipas. R-14.
14040. 3200 meters west of Rancho El Lobo on Loma de los Gringos, Rio Bravo Lot 1; Reynosa, Tamaulipas. R-14.
14041. Presa at Rancho Soledad, Rio Bravo Lot 1, Reynosa, Tamaulipas. S-15.
14042. 1.5 kilometers northeast of Rancho La Piedra, Rio Bravo Lot 1; Reynosa, Tamaulipas. S-15.
14043. At Campo La Llorona on irrigation ditch about 24 feet deep, Rio Bravo Lot 1; Reynosa, Tamaulipas. S-16.
14045. North bank of Rio San Juan, about 900 meters downstream from mouth of Arroyo San Antonio and 1.200 meters east of triangulation point Loma del Rio; Mier, Tamaulipas. K-7.
14046. 3.2 kilometers southwest of Ochoa station, Camargo, Tamaulipas. K-9 and L-9.
14048. 11,500 meters N. 30° W. from San Fernando, San Fernando, Tamaulipas. V-29.
14049. Brecha S. 42° E. from Rancho La Arena-La Ermita road, 90 meters to the southeast; China, Nuevo León. D-18.
14050. Near crest of structure on Rancho La Ermita-La Arena road; China, Nuevo León. D-18.
14051. 400 meters east of Charro No. 1, on hills making escarpment, Rio Bravo Lot 1; Reynosa, Tamaulipas. R-11.
14052. 1 kilometer west of Pocitos; Rio Bravo Lot 1; Reynosa, Tamaulipas. Q-12.



14053. 5880 meters northeast of Camargo No. 1 near triangulation point Coma; Camargo, Tamaulipas. L-6 and L-7.
14054. 2.8 kilometers S.  $50^{\circ}$  E. of Rancho Cabeza del Toro, Carlos Cantú, China, Nuevo León. I-17.
14055. 2.5 kilometers S.  $30^{\circ}$  E. of Rancho Charco de Piedra, China, Nuevo León. I-18.
14056. Small arroyo north of Monterrey-Reynosa highway, 7000 feet southeast of triangulation point Cuervito No. 2; Zacate, General Bravo, Nuevo León. M-12.
14063. 2180 meters S.  $19^{\circ}$  E. from Rancho Medina, Carlos Cantú, China, Nuevo León. J-19.
14144. 5800 meters N.  $77^{\circ}$  E. of Rancho Palo Blanco on east bank of Arroyo San Lorenzo; Carlos Cantú, China, Nuevo León. P-22.
14146. 8000 meters S.  $50^{\circ}$  E. from Rancho Palo Blanco in Arroyo Mezquite; Carlos Cantú, San Fernando, Tamaulipas. P-23.
14147. 5150 meters N.  $60^{\circ}$  E. from Rancho Palo Blanco on east bank of Arroyo San Lorenzo; Carlos Cantú, China, Nuevo León. O-22.
14148. 2250 meters north from Rancho Barretosa and 4050 meters west from Rancho El Canon; Santa Ana, Carlos Cantú, San Fernando, Tamaulipas. M-25.



TABLE 2.—Distribution of the Mollusca in the lower Eocene

[illegible]











TABLE 4.—*Distribution of the Mollusca in the Jackson formation*

	JACKSON FORMATION												
	Lower and Middle						Upper						
	13753 K-7 Roma sandstone member	13507 M-7	13508 M-5, M-6	13754 M-7	13506 M-7	13504 M-8	13503 N-8	13598 L-11	*13467 M-11	14009 M-13	13520 N-10	13513 M-11	13527 M-11
<i>Nucula spheniopsis</i> Conrad.....						x							
<i>Calorhadia (Litorhadia) mater</i> (Meyer).....			?										
<i>Pteria limula</i> (Conrad).....							x						
<i>Atrina jacksoniana</i> Dall.....													?
<i>Mesodesma singleyi</i> (Harris).....	x												
<i>Corbula (Varicorbula) azucar</i> Gardner, n. sp.....				x		x				x			
<i>Panope oblongata</i> (Conrad).....											?		
<i>Dentalium (Antalis) mississippiense</i> Conrad.....			?			?	?						
<i>Cadulus (Polyschides) jacksonensis</i> Meyer.....						?	?						
<i>Cirsotrema? cortezi</i> Gardner, n. sp.....								x	?				
<i>Architectonica alveata</i> Conrad.....						x							
<i>A. josephi</i> Gardner, n. sp.....						x							
<i>Turritella arenicola</i> Conrad.....			x			x							
<i>Calyptrophorus velatus</i> Conrad, s. l. ....						x							
<i>Tritiaria? zacatensis</i> Gardner, n. sp.....						x							
<i>Buccitriton hilli jacksonensis</i> (Johnson).....						?						x	
<i>Pseudoliva vetusta</i> (Conrad).....						?							
<i>Ancillopsis subglobosa</i> Conrad.....						?							
<i>Xancus wilsoni</i> (Conrad).....								?					
<i>Mitra (Fusimitra) millingtoni</i> Conrad.....						x							
<i>Volutospina symmetrica</i> (Conrad).....						x		?					
<i>Hesperiturris zacatensis</i> Gardner, n. sp.....										x			
<i>Pleurofusua collaris</i> Casey.....												?	
<i>Conus (Leptoconus) tortilus</i> Conrad.....					x	x		x		x			
<i>Nucleopsis</i> sp.....												x	
<i>Acteocina melinoides</i> Gardner, n. sp.....						x	x					x	
<i>Volvulella garzai</i> Gardner, n. sp.....						x	x					x	
<i>Lithophysema stewarti</i> Gardner, n. sp.....													
<i>Aturia alabamensis</i> (Morton).....		x											x

\* May be middle Jackson.







TABLE 6.—*Distribution of the Mollusca in the Miocene*

	GUAJALOTE FORMATION						OAKVILLE SANDSTONE				
	13574 U-23	13584 V-29	13585 V-29	13455 W-29	13587 W-30	13588 W-30	14038 R-14	14039 R-14	14041 S-15	13608 S-20	13573 U-23
<i>Pecten (Pecten)</i> sp. cf. <i>P. (P.) macdonaldi</i> Olsson.....						x					
<i>Chlamys (Lyropecten?)</i> sp. cf. <i>C. (L.?) nicholsi neotera</i> Gardner.....		x		x		x					
<i>C. (Nodipecten) dumblei</i> Gardner, n. sp.....		x	x		x	x					
<i>Ostrea</i> sp. cf. <i>O. cahobasensis</i> Pilsbry and Brown.....							x	x	x	x	x
<i>Cerastoderma (Dinocardium) cabezai</i> Gardner, n. sp.....	?	?	?	?	?	?					
<i>Callocardia (Agriopoma) calceola</i> Gardner.....						?					
<i>Clementia (Egesta)</i> sp. cf. <i>C. (E.) grayi</i> Dall.....				x		x					
<i>Scalina escandoni</i> Gardner, n. sp.....						x					
<i>Turritella subgrundifera</i> Dall.....		x				?					
<i>Uzita waltonensis</i> (Gardner).....		?				?					
<i>Oliva</i> sp. cf. <i>O. liodes</i> Dall.....		x		x		x					
<i>Pleuroliria tenagos</i> Gardner.....						?					



# SYSTEMATIC DESCRIPTIONS

Phylum VERMES

Class CHAETOPODA

Genus *Tubulostium* Stoliczka

1868. *Tubulostium* STOLICZKA, Geol. Survey India Mem., Palaeontologia indica, Cretaceous fauna of southern India, vol. 2, pp. 236-237.

TYPE, BY SUBSEQUENT DESIGNATION? Cossmann, Essais de paléoconchologie comparée, vol. 9, p. 140, 1912: *Serpula spirulaea* Lamarck.

The complexities of the nomenclature of this little-understood group have been discussed, if not resolved (U. S. Geol. Survey, Prof. Paper 193-B, p. 17, 1939).

*Tubulostium cortezi* Gardner

1939. *Tubulostium cortezi* GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 20, pl. 6, figs. 16-19.

Shell moderately compressed, discoidal or low turbate, rather small but heavy and crude. Early adnate portion of shell relatively large but known only from fragments retained on a few individuals. Adult portion of tube shielded by dense callus, performing between 1 and 2 visible turns, the final whorl largely enveloping the preceding and dextral or sinistral to attached area. Apertural portion produced tangent to shell, occasionally, as in the holotype, to a length as great as the diameter of the disk. Both upper and lower surfaces of disk rudely furrowed; surface near suture convex and cut off from flattened outer portion, which simulates a wide peripheral flange; commonly an abrupt change in sculpture pattern on free portion of tube, which may record only growth lines and heavy resting stages; free part of tube subject to breakage, the fragment suggesting *Hamulus* in outline and texture. Pronounced thickening of shell commonly observed at angle between disk and tangent tube. Small central depression suggesting an umbilical opening usually visible.

DIMENSIONS OF HOLOTYPE: Height, 3.7 millimeters; maximum diameter, 9.2 millimeters; diameter at right angles to maximum diameter, 8.8 millimeters; length of free portion of tube, 9.0 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497155.

TYPE LOCALITY: U.S.G.S. sta. 13631 (in original description 13630 by error) (M-25); in the narrow discocyclinid zone which overlies the *Ostrea lisbonensis* bed, on south side of gravel scarp near Tamaulipas-Nuevo León State line and about 1 kilometer east of road from Presa Nueva to Rancho Las Estacas, Santa Ana, China, Nuevo León. Mount Selman formation.

*Tubulostium cortezi* exhibits several characters by which it may be separated from the other *Tubulostiums* of the Eocene of the western Gulf—the relatively large attachment area, the crude shell, the irregular surface of the disk, the much-produced free apertural portion, and the tendency to develop irregular bumps and depressions. Though abundant at the single locality, *Tubulostium cortezi* has not been reported elsewhere.

Phylum MOLLUSCA

Class PELECYPODA

Order PRIONODESMACEA

Superfamily NUCULACEA

Family NUCULIDAE

Genus *Nucula* Lamarck

1799. *Nucula* LAMARCK, Prodrôme d'une nouvelle classification des coquilles: Soc. hist. nat., Paris, Mém., p. 87.

TYPE, BY MONOTYPY: *Arca nucleus* Linnaeus. Recent in the European seas.

The group has been exhaustively treated by Schenck (Mus. roy. hist. nat., Belgique, Bull., t. 10, no. 20, pp. 1-78, pls. 1-5, Bruxelles, June, 1934).



Valves not gaping; shell nacreous in texture, small, trigonal to subcircular to elliptical. Umbones subcentral or posterior, proximate, opisthogyrate. Escutcheon, and more rarely the lunule, clearly indicated though not sharply defined. External surface commonly concentrically striate or rugose with a more or less obvious subcutaneous radial lineation. Two series of crowded, chevron-shaped hinge teeth, the anterior the longer and the individual teeth diminishing rapidly in size along the margin of the chondrophore; the posterior series shorter and more uniform in size and direction. Chondrophore narrow, inclined obliquely forward. Anterior and posterior muscle scars subequal, inconspicuous. Pallial line simple. Inner margin finely crenate in harmony with the radial lineation.

Schenck (1934, p. 22) refers to *Nucula s. s.*, the Lower Cretaceous species *Nucula gaultina* J. Starkie Gardner; closely related forms earlier included under *Nucula* have been described from the Paleozoic. The wide distribution of the Recent species suggests a stock deeply rooted in the past. Though characteristic of the boreal and temperate oceans today, the group has also a meager representation in the tropical seas. It is found in both shallow and deep water and on both sandy and muddy bottoms.

*Nucula* sp. aff. *N. mediavia* Harris

Synonymy and description of *Nucula mediavia* Harris:

1886. *Nucula magnifica* Conrad. ALDRICH, Geol. Survey Alabama, Bull. 1, p. 60 (name only).  
 Not *Nucula magnifica* Conrad, 1833, Fossil shells Tertiary formations of North America, p. 37.  
 1896. *Nucula mediavia* HARRIS, Bull. Am. Paleontology, vol. 1, no. 4, p. 53, pl. 4, fig. 4.  
 1935. *Nucula mediavia* Harris. GARDNER, Univ. Texas Bull. 3301, p. 116 (Not 1933, as on title page).

"Size and general form about as figured; surface showing besides lines of growth, many radiating striae; lunule large, deeply depressed, and sometimes traversed by a faint radiating ridge; within, strongly crenulate at margin; posterior as well as anterior row of teeth well developed, each tooth angulate in the middle; angle formed at the junction of the two rows of teeth about 130 degrees.

"The sharp posterior, deeply sunken and sharply defined lunule, great angle formed by the junction of the two rows of teeth, and coarsely crenulated margin, serve to distinguish the species."—Harris, 1896.

*Nucula mediavia* may be the forerunner of *Nucula magnifica* of the Claiborne fauna, from which it differs in the higher anterior dorsal margin, the more pronounced "lunule", and the stronger radial sculpture.

The Mexican material is rather fragmentary, and even fragments are rather rare. These are only generically determinable, but no characters are retained by which they may be separated from the Midway species of Alabama.

DISTRIBUTION: Midway formation: ? upper Midway, U.S.G.S. sta. 13462 (E-18).

*Nucula mauricensis* Harris

1919. *Nucula magnifica* var. *mauricensis* HARRIS, Bull. Am. Paleontology, vol. 6, p. 73, pl. 26, figs. 4-6.  
 1928. *Nucula magnifica mauricensis* Harris. PRICE AND PALMER, Jour. Paleontology, vol. 2, no. 1, p. 24, pl. 7, figs. 6, 8.  
 1931. *Nucula magnifica* Conrad var. *mauricensis* Harris. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 105, 108.

The species was described only differentially by Harris:

"So far as we have observed typical *magnifica* occurs only in the Claiborne sand at Claiborne and nearby localities. The umbonal region seems heavy, deep, inturning, when compared with the same parts of individuals from the St. Maurice stage (var. *mauricensis* n. var., figs. 4-6)."

No type was selected, but specimens were figured from Elm Creek, Texas, and from the base of the bluff just above the upper landing at Claiborne, Alabama. The left valve from Elm Creek, (op. cit., fig. 4) is here designated as the lectotype.

*Nucula mauricensis* Harris is smaller and thinner than *N. magnifica* Conrad, rarely exceeding 15 millimeters in maximum dimension, whereas the width of the Claiborne species reaches almost 30



millimeters. The radial sculpture, as on *N. magnifica*, is stronger and more evenly developed than that of *N. ovula* Lea, and the margin of the escutcheon is not so conspicuously raised.

The occurrence of the typical *Nucula magnifica* in the lower Claiborne of the western Gulf has not been verified, and probably all forms listed under that name should be referred to *N. mauricensis* Harris. The specimens from Elm Creek, the highest stratigraphically, approach the most closely to *N. magnifica*, but even these do not attain a width of 20 millimeters.

The species is probably represented at several localities in Mexico in the vicinity of Rancho El Prieto and Rancho Barretosa, and possibly at U.S.G.S. sta. 13619 (H-17) in the thin slabs of concretionary limestone closely studded with single valves of a small *Nucula*, each valve resting face down.

DISTRIBUTION: Laredo formation: lower Laredo, ? U.S.G.S. sta. 13619 (H-17); middle Laredo, U.S.G.S. sta. 13986 (G-2); U.S.G.S. sta. 13772 (G-3); U.S.G.S. sta. 13480 (F-4); U.S.G.S. sta. 13567 (H-11); ? U.S.G.S. sta. 13643 (M-25); upper Laredo, U.S.G.S. sta. 13768 (G-3).

#### *Nucula* sp.

South of Laredo in Webb County, Texas, and at a few localities in northeastern Mexico, the rock is made up largely of a *Nucula* which is probably distinct from any described species, though very close to *N. magnifica* Conrad. It is large—about 30 millimeters high and equally broad—and sculptured with prominent growth lines and a uniformly developed subcutaneous radial threading. No hinges or perfect exteriors have been found, but the pearly fragments of the thick shell pack the matrix.

*Nucula* sp. is abundant in the middle part of the Laredo formation at U.S.G.S. sta. 8818, 5 miles southeast from Laredo, Webb County, Texas; in Mexico at U.S.G.S. sta. 13634 (M-24), ?U.S.G.S. stas. 13644 and 13645 (M-25); and in the upper Laredo at U.S.G.S. sta. 13979 (H-5); and U.S.G.S. sta. 13542 (J-13).

#### *Nucula spheniopsis* Conrad

(Plate 1, figure 3)

1865. *Nucula spheniopsis* CONRAD, Am. Jour. Conchology, vol. 1, p. 140, pl. 10, fig. 13.

1898. *Nucula spheniopsis* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 577.

“Obliquely ovate-triangular, slightly ventricose; posterior side cuneiform, extremity acutely rounded; inner margin minutely crenulated.” Conrad, 1865.

The locality is incorrectly given. The shells were not from Enterprise as Conrad states, but from the Jackson formation at Garlands Creek, 3 miles east of Shubuta, Mississippi (Aldrich, T. H., Am. Jour. Sci., 3d ser., vol. 30, p. 307, 1885).

The left valve (U. S. Nat. Mus. 495920) figured from the Jackson formation of Mexico is 10 millimeters high and 12.3 millimeters broad. It seems a little heavier than the usual examples from the Jackson of Mississippi, but the form, dimensions, and simple sculpture pattern are similar in the shells from the two localities.

*Nucula spheniopsis* may well be in the line of descent from *Nucula mauricensis* Harris. It has much the general aspect of the group of *mauricensis* represented in the Claiborne of Webb County, Texas, south of Laredo, but the Jackson species is more oblique, more produced, and acutely rounded anteriorly.

DISTRIBUTION: Jackson formation: lower or middle Jackson; U.S.G.S. sta. 13504 (M-8).

#### *Nucula* sp. A

A *Nucula* from the indurated sandstones of the lower marine Oligocene is smaller, more trigonal, and decidedly heavier than *Nucula spheniopsis* and much heavier, too, than *N. vicksburgensis*. The outline is characteristic. Both the anterior and the posterior areas are flattened and relatively wide, thus throwing the umbones into prominence. The anterior margin is obliquely truncate, produced, and obtusely rostrate from the beaks to the base. An average specimen is 6.5 millimeters high and 7.0 millimeters wide. Collections were made at U.S.G.S. sta. 13511 (M-11); and U.S.G.S. sta. 13522 (M-11).



*Nucula* sp. B

A small *Nucula*, a little less than 5 millimeters high, with a slightly greater width, is fairly common in the lower marine Oligocene sandstone at U.S.G.S. stas. 13510 and 13511 (M-11), Zacate, General Bravo, Nuevo León. The characteristic feature of the shell is a regular concentric lamination, strongly developed for the genus. The umbones are set well to the rear. The posterior end is obliquely truncate; the anterior, produced and broadly rounded. The hinge is not accessible.

## Family NUCULANIDAE

Aug. 9, 1930. STEWART, Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, p. 48.

Stewart has given a detailed and documented discussion of the family commonly known as the Ledidae, and he offers no escape from the conclusion that *Leda* must be replaced by *Nuculana*, the senior name by 10 years. He has also made a much-needed division of the heterogeneous group of "*Leda*" and restricted to *Nuculana* those forms best characterized by the narrow and asymmetric ligament pit. The restricted group has no recognized representation in the Gulf Eocene. It includes for the most part Recent species of boreal or north temperate distribution.

Genus *Nuculana* Link

1807. *Nuculana* LINK, Beschreibung der Naturalien-Sammlung der Universität zu Rostock, p. 155.  
Type, by monotypy, *Arca rostrata* Chemnitz = *Arca pernula* Müller.  
1817. *Leda* SCHUMACHER, Essai d'un nouveau système des habitations des vers testacés, p. 172.

TYPE, BY MONOTYPY: *Arca rostrata* Chemnitz = *Arca pernula* Müller. Recent in the North Polar seas and in the North Atlantic.

The genotype is a shell of medium dimensions, moderately high, with slightly anterior umbones, an obtuse posterior keel, and a crude concentric wrinkling. The lunule is merely suggested, and the escutcheon less sharply defined than it is in most Gulf Eocene species. Stewart stressed the importance of the small, asymmetric chondrophore, inclined posteriorly along the compressed posterior series of taxodont teeth.

The group is peculiarly characteristic of the Recent northern seas, and it is not surprising that it should be without representation in the warm-temperate Eocene waters.

An unfortunate feature in abandoning a name with a generalized concept such as *Leda* in favor of one with a specialized concept such as *Nuculana* is that we have no satisfactory term to use for poorly preserved and only partially identifiable material. In numerous collections from northeastern Mexico, there are transversely elongate, concentrically striate taxodonts which would formerly have been referred to *Leda* s. l., but which are not *Nuculana* and do not retain characters sufficient to allocate them to any restricted genus.

Genus *Ledina* Dall

- Oct. 1898. *Ledina* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 580.  
Not *Ledina* Sacco, December, 1898, I Molluschi dei Terreni Terziarii del Piemonte e della Liguria, pt. 26, p. 53.

TYPE, BY ORIGINAL DESIGNATION: *Leda smirna* Dall = *Leda eborea* Conrad, 1860, not *Nucula eborea* Conrad, 1846. Midway of the Gulf Province.

"Shell solid, strong, arcuate below, both ends evenly rounded, valves nearly equilateral, smooth.

"This section has been frequently placed with *Yoldia*." Dall, Oct., 1898.

Stewart (Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, p. 53, 1930) allied *Ledina* with *Jupiteria* Bellardi, 1875 (type *Nucula concava* Bronn, from the upper Tertiary of northern Italy), represented in the fauna from Bowden, Jamaica. The upper Tertiary species are smaller, lighter, and relatively higher shells than the lower Eocene forms, which are porcellaneous and look more like the *Yoldias*, but they lack the characteristic insinuation of the pallial line of the long-siphoned *Yoldia*.



*Ledina smirna* Dall

(Plate 4, figure 4)

1860. *Leda eborea* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 295, pl. 47, fig. 26. Not *Nucula eborea* Conrad, Acad. Nat. Sci. Philadelphia, Proc., vol. 3, p. 24, 1846. (= *Leda concentrica* (Say) 1824.)
1890. *Leda* (*Yoldia*) *eborea* Conrad, DE GREGORIO, Annales Géologie et Paléontologie, vol. 8, p. 187, pl. 22, fig. 37.
1894. *Leda* (*Yoldia*) *eborea*? Conrad. HARRIS, Geol. Survey Arkansas, Ann. Rept. for 1892, vol. 2, p. 42.
1896. *Yoldia eborea* Conrad. HARRIS, Bull. Am. Paleontology, vol. 1, no. 4, p. 56, pl. 4, fig. 7.
1898. *Leda* (*Ledina*) *smirna* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 580.
1935. *Leda* (*Ledina*) *smirna* Dall. GARDNER, Univ. Texas Bull. 3301, p. 121, pl. 6, fig. 11. (Not 1933, as on title page.)

Conrad, 1860, gave to the Eocene species a name he had already used in describing a Recent shell off the west coast of Florida. Dall's *smirna* merely replaces the preoccupied *eborea*.

TYPE LOCALITY: The figured right valve, U. S. Nat. Mus. 155133, from Matthews Landing, Wilcox County, Alabama, may be a topotype.

*Ledina smirna* is ovate in outline, well rounded, polished, and commonly shows color bands that may be the remnant of the original pattern. The incised lines on the medial portion of the shell are regular and sharp but are less distinct anteriorly and in most individuals completely disappear in front of the rounded posterior keel.

In Alabama, *Ledina smirna* Dall is restricted to the Matthews Landing horizon but is preceded in the lower Midway by a larger, less trigonal species.

In Texas, *Ledina smirna* has a wide distribution in the upper Midway. It is common also in the upper part of the Kincaid on the Brazos and Colorado rivers but is apparently absent in the basal greensands.

A few imperfectly preserved shells or molds referable to this or a closely related species have been recovered from the upper Midway of northeastern Mexico.

DISTRIBUTION: Midway formation: upper Midway; ? U.S.G.S. sta. 13488 (D-18); ? U.S.G.S. sta. 13765 (E-18); upper Midway or possibly basal Wilcox, ? U.S.G.S. sta. 13462 (E-18); ? U.S.G.S. sta. 13450 (D-19).

Genus *Calorhadia* Stewart

1930. *Calorhadia* STEWART, Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, p. 51.

TYPE, BY ORIGINAL DESIGNATION: *Leda pharcida* Dall. Bashi formation, Wilcox group, Eocene of Alabama.

Shell porcellaneous, relatively large or of medium dimensions, not inflated, transversely elongate. Umbones subcentral or slightly anterior, inconspicuous, feebly opisthogyrate. Lunule linear but sharply defined by the abrupt depression of the shell and the disappearance of the concentric sculpture. Escutcheon linear-lanceolate, produced almost to the extremity of the posterior keel, bisected by a line extending from the umbones almost to the distal extremity of the dental series. Anterior end rounded, the posterior produced and bicarinate; an obscurely defined ray extending from the umbones to the antero-ventral margin. Entire outer surface except the lunule and escutcheon adorned with concentric lamellae, regularly spaced, arranged medially like clapboards and attached by their ventral edges, flaring anteriorly and conspicuously rugose posteriorly. Ligament pit small, trigonal, deeply sunken. Dentition strong and crowded; teeth chevron-shaped and diminishing in size toward the umbones. Muscle scars moderately large, not conspicuous. Pallial sinus broadly U-shaped.

The group is particularly characteristic of the Eocene of the Gulf Province.

Subgenus *Litorhadia* Stewart

1930. *Litorhadia* STEWART, Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, p. 52.

TYPE, BY ORIGINAL DESIGNATION: *Leda acala* Dall. Bashi formation, Wilcox group, Eocene of Alabama.



"In outline, *Leda acala* Dall from Wood's Bluff, Alabama, much resembles typical *Nuculana*, but the hinge, lunule, and escutcheon are similar to that of *Calorhadia*. The resemblance to *Nuculana* is due to the short anterior extremity, but the two forms, considering the difference in the hinges, are probably not closely related." Stewart, 1930.

The most obvious differences between this group and *Calorhadia* Stewart are the absence in *Litorhadia* of the posterior double carination and the obsolete or obtuse concentric sculpture so sharply developed in the group typified by *Calorhadia pharcida* (Dall). The posterior extremity of *L. acala* is nasute, and there is a change in direction in the growth lines but no angulation of the whorl, no raised line, and no marginal truncation. The sculpture is limited to growth lines sharpest near the medial ventral margin.

Two of the middle Eocene species, *C. bastropensis* (Harris) and *C. lisbonensis* (Aldrich), show a fairly strong and regular but not acute concentric sculpture on the anterior and medial portions of the shell. The characteristic posterior keel is, however, absent, and the species in question have been included under *Litorhadia*, though they are not typical.

*Calorhadia (Litorhadia) santa-anai* Gardner, n. sp.

(Plate 5, figure 9)

Shell transversely elongated. Umbones submedial, broadly rounded but rather low. Dorsal margins oblique, the anterior only slightly higher than the posterior. Anterior extremity sharply rounded, the posterior end broken but probably rostrate. Ventral margin very broadly curved. Tips of the umbones sharp and turned slightly backward. Characters of lunule and escutcheon lost by the imperfection of the material. Concentric sculpture of sharp and sharply elevated threads running about 4 to the millimeter upon the disk, unusually regular in size and in arrangement. Characters of the interior obscured by the matrix.

DIMENSIONS OF HOLOTYPE: Height, 5.8 millimeters; length, 10 millimeters.

HOLOTYPE, A RIGHT VALVE: U. S. Nat. Mus. 495047.

TYPE LOCALITY: U.S.G.S. sta. 13462. ?Upper part of Midway formation.

*Litorhadia santa-anai* is described from admittedly inadequate material, but its characters are so diagnostic that it is herewith presented in the hope that it may have stratigraphic value. It is remarkable for the symmetry of the outline, the low subcentral umbones, the dorsal margins declining at almost equal angles, and the strong concentric sculpture.

DISTRIBUTION: Midway formation: lower Midway, ?U.S.G.S. sta. 13473 (B-6); ?U.S.G.S. sta. 13472 (B-6); ?upper Midway, U.S.G.S. sta. 13462 (E-18).

*Calorhadia (Litorhadia) sp.*

Impressions and molds suggesting miniature "*Leda*" *elongatoidea* Aldrich are common in indurated fine-grained sandstone from the upper part of the Indio formation, 250 meters south of the brecha crossing in Arroyo Santo Domingo (U.S.G.S. sta. 13689, E-5).

It seems worth while to note them, for the lithology is unusual for the area, and the nuculanid impressions are unlike any observed elsewhere.

*Calorhadia (Litorhadia) sp.*

Impressions of a compressed, transversely elongated species with decidedly anterior beaks occur rather commonly in the Carrizo sand of Nuevo León (U.S.G.S. sta. 13477, F-4). The outline recalls *Leda elongatoidea* Aldrich, from the lower and middle Wilcox, and *Leda mater* Meyer, a characteristic and widely distributed species in the Jackson.

*Calorhadia (Litorhadia) compsa* (Gabb)

1860. *Leda compsa* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 387, pl. 67, fig. 57.

1891. *Leda compsa* Gabb. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc., p. 403.

1919. *Leda opulenta* var. *compsa* Gabb. HARRIS, Bull. Am. Paleontology, vol. 6, no. 31, p. 62, pl. 24, figs. 1-2.

1931. *Leda opulenta* var. *compsa* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 104.



"Inequilateral; beaks very small, incurved; shell rounded anteriorly, acuminate posteriorly; basal margin very regularly curved; hinge teeth very small, fosset triangular; surface marked by numerous transverse ribs, smaller in the middle than elsewhere, doubling in thickness and changing their direction on the umbonal ridge, and continuing somewhat larger posterior to the ridge than in advance of it; there is a furrow immediately posterior to the ridge, about equal in size to the ridge itself.

"Dimensions.—Length .45 in., width 1.3 in., height of valve .1 in.

"Locality.—Caldwell Co., Texas." Gabb, 1860.

TYPE: Academy of Natural Sciences of Philadelphia (?).

*Calorhadia compsa* (Gabb) is remarkable for its relatively large size (nearly 30 millimeters in width), the close and rather prominent concentric sculpture, the wide posterior area, cut off, except in the youngest individuals, by a sulcus behind the nodular rostral ray, and the tendency toward the development of a second nodular ray at the margin of the escutcheon.

The species is not uncommon but so fragile that perfect specimens are rare.

Harris, 1919, considered *compsa* as a varietal form of *opulenta*, differing from it in that "the space 'with regular prominent striae' is wider than in the Claiborne form; the shell itself, however, is usually smaller." These differences are significant stratigraphically and are sufficient to separate specifically the upper and the lower Claiborne forms.

In Texas the species has been reported from both the Weches and the Cook Mountain formations. It is relatively rare in Mexico and fragmentary.

DISTRIBUTION: Laredo formation: middle Laredo, U.S.G.S. sta. 13480 (F-4); ?U.S.G.S. sta. 13643 (M-25); U.S.G.S. sta. 13641 (M-25).

#### *Calorhadia (Litorhadia) bastropensis* (Harris)

1895. *Leda bastropensis* HARRIS. Acad. Nat. Sci. Philadelphia, Proc., p. 46, pl. 1, fig. 3.

1919. *Leda bastropensis* HARRIS. Bull. Am. Paleontology, vol. 6, no. 31, p. 64, pl. 24, figs. 9, 10.

1931. *Leda bastropensis* Harris. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 104.

"General form as figured; medial portions of the valves with regular, strong, concentric striae; striae obsolete on the anterior end and on the post-umbonal slope, the latter with a shallow furrow extending from the umbo to near the extremity of the valve; within the valve, a raised line or ridge, emanating from the umbonal region and extending along beneath the hinge finally terminates in the middle of the posterior end and is there slightly enlarged.

"This species differs from *L. plicata* Lea in its lack of striation over portions of the exterior, and the more central positions of the umbones. From *L. mater* Mr., *bastropensis* is distinguished by its want of anterior radiating sulci, its lack of post-umbonal striation, and by its form. This is readily distinguished from *L. albirupina* Har. since it lacks the smooth *Yoldia*-like aspect about the umbones so characteristic of that species.

"Localities.—Rio Grande at Starr-Zapata Co. line; Brazos River, one mile below Milam-Burleson Co. line, Tex.

"Geological horizon.—Lower Claiborne Eocene."

"Type.—In Texas State Museum." Harris, 1895.

The figure indicates a shell 11 millimeters long, but no dimensions were given, and the type is apparently missing from the Harris material in Austin.

The shells figured by Harris in 1895 and in 1919 seem to represent two species; that figured in 1919 (Bull. Am. Paleontology, vol. 6, pl. 24, fig. 9) is certainly the form so abundant both on the Texas and the Mexican side of the Rio Grande. However, it has not been recognized except in the Embayment faunas, and an author would hardly have selected the name *bastropensis* for a species not represented in Bastrop County. Fortunately, Harris did not specify in so many words in 1895 that the form which he figured was the type, and he did in 1919 in his description of plate 24, figure 9, state "type, Texas State Museum." The name may be a misnomer, and the type may be lost, but the figure is clearly recognizable, and the specimen was in all probability derived from the locality which he describes as the "Starr-Zapata Co. line on the Rio Grande."

DISTRIBUTION: Laredo formation: middle Laredo, U.S.G.S. sta. 13861 (H-4); U.S.G.S. sta. 13990 (H-9); ?U.S.G.S. sta. 13643 (M-25); upper Laredo, ?U.S.G.S. sta. 13935 (H-3).

#### *Calorhadia (Litorhadia)* sp.

The anterior and medial portions of an exceptionally fine left valve allied, possibly, to *C. trumani* (Harris) is associated with *Turritella cortezi* in the middle Laredo limestones northwest of Mier. The



diagnostic posterior portion is lost. The height of the valve is 15.5 millimeters; the width may well have exceeded 35 millimeters. The concentric lirae are well formed, coarse, and elevated for the group, and regular in the spacing of about 3 to the millimeter on the disk. In the dimensions and prominence of the concentric sculpture, this imperfect valve outclasses all other Claiborne nuculanids. It is known, unfortunately, only from U.S.G.S. sta. 13772 (G-3).

*Calorhadia (Litorhadia) sp.*

(Plate 1, figure 8)

A small nuculanid collected 4500 meters east of Rancho Presa Nueva, Santa Ana, Nuevo León, does not conform to the restrictions of any of the described species; but it is too imperfectly preserved to name. The outline is similar to that of *Sacella*, but *Sacella* is unirostrate, while the valve in question is bicarinate. There are no visible characters other than the small size to suggest that the shell is juvenile. The disk is moderately convex, the umbones flattened, inconspicuous, and turned slightly backward. The dorsal area in front of the beaks is shorter than that behind them and is feebly compressed toward the lateral extremity. The dorsal margins are oblique, the ventral broadly and smoothly rounded. A well-defined but not conspicuous secondary keel lies a little in front of the primary keel, and a sharply raised line bisects the escutcheon. The lunule is linear, but it extends the length of the dorsal margin. The entire surface from the lunular margin to the secondary keel is concentrically threaded. In the umbonal area the lirae are very fine and sharp, but they become coarser and more rounded toward the ventral margin. They seem to be partially obliterated between the secondary and the primary keels; they reappear and override the primary keel but abruptly disappear at the margin of the escutcheon. The characters of the interior are not accessible.

The species has something of the aspect and sculpture pattern of *Calorhadia media* (Lea) of the upper Claiborne, but *C. media* is more elongated transversely, and the sculpture pattern is rubbed out over the anterior third of the shell. In the Mexican form the concentric threading persists without diminution of strength to the lunular margin.

The height of the figured right valve (U. S. Nat. Mus. 495922) is 3.1 millimeters; the width 6 millimeters.

The locality, U.S.G.S. sta. 13634 (M-24), falls in the middle part of the Laredo formation.

Only three valves were recovered, all of them about equal in size and from the same collection.

*Calorhadia (Litorhadia) mater* (Meyer)

Synonymy and description of *Calorhadia (Litorhadia) mater* (Meyer):

- 1885. *Leda mater* MEYER, Am. Jour. Sci., 3d ser., vol. 29, pt. 1, p. 460.
- 1886. *Leda mater* MEYER, Geol. Survey Alabama, Bull. 1, pt. 2, p. 79, pl. 3, fig. 20.
- 1894. *Leda mater* Meyer. HARRIS, Geol. Survey Arkansas, Ann. Rept. for 1892, vol. 2, p. 147.
- 1898. *Leda mater* Meyer. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 578.

*Calorhadia mater* Meyer described from Jackson, Mississippi, is a fragile little shell with the posterior portion produced to almost twice the length of the rounded anterior end. The umbones are flattened and turned inward to an unusual degree and slightly backward. The valve is bicarinate, and both keels are acute and elevated. The area between them is adorned with a subdued concentric sculpture; behind the second keel and between it and the acutely raised margin of the lanceolate escutcheon, the surface is slightly concave, smooth, and shining. The concentric threading is relatively sparse on the umbonal area but close and regular on the ventral portion of the shell. A more or less obscure ray of flattened sculpture falls from the umbone to the anterior ventral margin. The species is most readily diagnosed by the produced, bicarinate, posterior end and the close concentric threading. In the Western Gulf region it is comparatively rare, possibly because the marine beds of similar age are, for the most part, more sandy than those of the Moodys Branch marl from which the type material was derived. In the Rio Grande Embayment, *Calorhadia mater* Meyer is associated with the sands and sandstones carrying, in great abundance, *Turritella arenicola* (Conrad).

DISTRIBUTION: Jackson formation: lower or middle Jackson, ?U.S.G.S. sta. 13508 (M-5, M-6).



*Calorhadia (Litorhadia) sp., cf. C (L.) lisbonensis* (Aldrich)

Synonymy and description of *Calorhadia (Litorhadia) lisbonensis* (Aldrich):

1895. *Leda lisbonensis* ALDRICH, Bull. Am. Paleontology, vol. 1, no. 2, p. 17, pl. 5, fig. 4.

1919. *Leda magna* var. *lisbonensis* Aldrich. HARRIS, Bull. Am. Paleontology, vol. 6, p. 63, pl. 24, figs. 5, 6, 7.

"Shell oblong, lanceolate; very inequilateral, the posterior part being nearly twice as long as the anterior; compressed; beak very small, smooth; escutcheon striated, depressed, bordered outwardly by a serrated rib; posterior slope with two ribs forming a flattening space; the posterior surface of the shell covered with rounded, close-set, transverse folds, which terminate centrally; anterior half smooth, with a depressed space running obliquely from the beak to the ventral margin; lines of growth faint, perceptible upon anterior; anterior margin rounded, convex, while the posterior is raised; teeth numerous, very closely set and pointed; fosset small, with rounded cavity.

"*Locality*.—Lisbon, Ala.

"*Geological horizon*.—Lower Claiborne.

"This remarkable species grows nearly three inches long, and is very distinct from any other tertiary form except *Leda magna* Lea, sp. It differs from that species, of which fragments are in my cabinet, by a remarkable lanceolate shape, and length of posterior." Aldrich, June 24, 1895.

HOLOTYPE: Aldrich collection, Johns Hopkins University, Baltimore, Maryland.

A right valve, a topotype (U. S. Nat. Mus. 495052), is figured (Pl. 1, fig. 7). The height is 13 millimeters, and the width of the complete shell is about 50 millimeters.

Aldrich gives no locality other than Lisbon, but in our collections *lisbonensis* occurs only in Bed No. 3 of the Cooke section (Ala. Geol. Survey, Spec. Rept. no. 14, p. 270), the level below that in which *Ostrea lisbonensis* is abundant. Imperfectly preserved specimens of a closely allied if not identical species occur above the *Ostrea lisbonensis* zone in the middle Laredo formation of northeastern Mexico, in General Bravo at U.S.G.S. sta. 13593 (I-13) and in Santa Ana, China, at U.S.G.S. sta. 13634 (M-24).

Genus *Sacella* Woodring

Dec., 1898. *Ledina* SACCO, I Molluschi dei Terreni Terziarii del Piemonte e della Liguria, pt. 26, p. 53.

Not *Ledina* Dall, October, 1898, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 580. Type, *Leda smirna* Dall; Midway of the Gulf Province.

May, 1925. *Sacella* WOODRING, Carnegie Inst. Washington, Pub. 366, p. 15.

Type of *Ledina* Sacco and *Sacella* Woodring, both by original designation: *Arca fragilis* Chemnitz = (*Nucula commutata* Philippi). Miocene to Recent in the Mediterranean region.

"Shell small, high, slightly inequilateral, posterior end rostrate, rostrum sharply pointed and unicarinate; a shallow groove extends from the umbo to the ventral margin at both ends of the valve; sculpture consisting of strong concentric rugae; hinge like *Leda* s.s., but the anterior and posterior series of teeth are approximately equal in length; apex of pallial sinus broadly U-shaped.

"*Sacella* resembles the section *Lembulus* Risso, but has a narrower and shallower posterior groove, and concentric instead of diagonal sculpture. There are no American late Tertiary or living species of *Lembulus*. The geographic distribution and difference in sculpture warrant the renaming of Sacco's section, although the hinge and pallial sinus of *Lembulus* and *Sacella* are similar." Woodring, 1925.

Stewart (Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, 1930) has discussed the involved synonymy of the group characterized by the small, high, trigonal outline and more or less well-developed concentric sculpture.

The group, which becomes increasingly prominent through the late Tertiary to the Recent, has a meager representation in the Midway of the Gulf Province. Molds and shell fragments indicate a fairly wide though not abundant distribution of *Sacella* in the lower Eocene of northeastern Mexico, but very little specifically determinable material has been recovered.

*Sacella* sp. cf. *S. atakta* (Gardner)

Reference to and description of *Sacella atakta* (Gardner):

1927. *Leda atakta* GARDNER, Washington Acad. Sci., Jour. vol. 17, no. 14, p. 364, figs. 7, 8.



Shell small, plump, constricted and rostrate posteriorly. Umbones subcentral, full; the tips proximate and opisthogyrate. Anterior dorsal margin obliquely descending; posterior dorsal margin slightly produced and feebly concave; base line arcuate, ascending posteriorly. Lunular area depressed but not well defined. Escutcheon produced for about half the distance from the umbones to the posterior ventral margin, feebly depressed; an elongate-cordate area enclosing the escutcheon, extending from the umbones to the extremity of the rostral ray. A second ray developed anterior to the rostrum, well defined but not conspicuous; its extremity indicated at the ventral margin by a slight jog. Concentric sculpture not developed on the umbonal area. Surface away from the umbones threaded with well-rounded lirae evanescent upon the anterior portion of the shell and abruptly disappearing a little in front of the secondary rostral ray. Rostrum incrementally striated but not threaded. Chondrophore minute, subumbonal. Dentition moderately strong; approximately 18 teeth in the anterior series; posterior series feebly concave, of nearly the same length as the anterior but less crowded, containing only about 15 component teeth. Adductor and pallial scars obscure. Shell reinforced by a slight thickening on the inner surface directly in front of the rostrum.

**DIMENSIONS OF HOLOTYPE:** Height 3.5 millimeters; length 6.0 millimeters; diameter 2.6 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 369241.

**TYPE LOCALITY:** Smithville, Bastrop County, Texas. Weches member of Mt. Selman formation.

*S. atakta* is not a typical *Sacella*, and the bicarinate rostrum suggests the *Calorhadia* group. However, the outline and dimensions of the type are those of *Sacella*. Poorly preserved individuals from the lower Mount Selman of northeastern Mexico at U.S.G.S. sta. 13991 (G-11) are similar in form and sculpture to *atakta*, but larger by a third. They may represent a new and distinct species or merely a larger race than that from the Mount Selman of Texas.

#### Genus *Adrana* H. and A. Adams

Jan., 1858. *Adrana* H. AND A. ADAMS, Genera Recent Mollusca, vol. 2, p. 547.

**TYPE, BY SUBSEQUENT DESIGNATION** (Stoliczka, Geol. Survey India, Mem., Palaeontologia Indica, Cretaceous Fauna of Southern India, vol. 3, p. 320, 1871): *Nucula lanceolata* Lamarck, 1819 = *Leda sowerbyana* d'Orbigny, 1823. Recent off the coast of Ecuador.

Shell thin and much elongated, gaping at both extremities.

#### *Adrana aldrichiana* Harris

1895. *Leda (Adrana) aldrichiana* HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 47, pl. 1, fig. 6.

1919. *Adrana aldrichiana* HARRIS, Bull. Am. Paleontology, vol. 6, p. 71, pl. 25, fig. 21. (Fig. 20 excluded.)

**TYPE LOCALITY:** One and a half miles below Mosley's Ferry, Brazos River, Texas.

**TYPE:** Aldrich Collection, Johns Hopkins University, Baltimore, Maryland.

The species in the later collections is represented only in the form of casts.

The form shown in figure 20 of plate 25, 1919, from a locality near Roberta, Louisiana, suggests the young of *Calorhadia lisbonensis* rather than *Adrana*.

Few species are better characterized than *Adrana aldrichiana*; the horizontal axis is about 5 times the length of the vertical, the ventral edge subparallel to the dorsal, and the dental series are almost coextensive with the hinge margins.

**DISTRIBUTION:** Laredo formation: upper Laredo, ?U.S.G.S. sta. 13935 (H-3).

#### Genus *Orthoyoldia* Verrill and Bush

1897. *Orthoyoldia* VERRILL AND BUSH, Am. Jour. Sci., 4th ser., vol. 3, p. 55.

1925. *Orthoyoldia* Verrill and Bush. WOODRING, Carnegie Inst. Washington, Pub. 366, p. 21.

1930. *Orthoyoldia* Verrill and Bush. STEWART, Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, p. 60.

**TYPE, BY ORIGINAL DESIGNATION:** *Yoldia scapina* (error for *scapania*) Dall. Recent off the Brazilian Coast.



"Shell oblong, gaping, blunt or rounded at both ends, without distinct rostrum; no carina. Pallial sinus large and broad. Teeth numerous in both series. *O. scapina* [error for *scapania*] (Dall) from off Brazil, and *O. solenoides* (Dall), from the West Indies." Verrill and Bush, 1897.

Woodring noted the ecological difference between *Yoldia* and *Orthoyoldia*. *Yoldia s. s.* is one of the most characteristic genera of the boreal seas, while *Orthoyoldia* is warm temperate and tropical. Woodring also noted that "*Yoldia psammotaea* Dall, a Claiborne (middle Eocene) species may be an *Orthoyoldia*, but its hinge is not known." The hinge of *psammotaea* was later recovered and justifies Woodring's tentative reference to *Orthoyoldia*.

### *Orthoyoldia psammotaea* (Dall)

(Plate 4, figures 2, 3)

1898. *Yoldia psammotaea* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 596, pl. 34, fig. 20.  
 1919. *Yoldia psammotaea* Dall. HARRIS, Bull. Am. Paleontology, vol. 6, p. 72, pl. 25, figs. 25-29.  
 1931. *Yoldia psammotaea* Dall. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 104.

"Shell smooth, or with faint incremental lines, inequilateral with low beaks, the dorsal and ventral margins subparallel; valves elongated, rounded in front and behind, the posterior part somewhat compressed and attenuated; anterior end with a moderate gape; lunule and escutcheon elongated, very narrow, almost linear. Lon. 21, alt. 9, diam. 6 mm." Dall, 1898.

TYPE LOCALITY: Base of bluff at Claiborne, Alabama.

In Texas, *Orthoyoldia psammotaea* is known both from the Mount Selman formation and from the Cook Mountain. The figured right valve, U. S. Nat. Mus. 559400, is from the Weches horizon at Smithville, Bastrop County. It is 4.3 millimeters high and 8.5 millimeters in breadth.

The Texas and Mexican individuals are sculptured with very low, overlapping lamellae almost or entirely obsolete posteriorly. The chondrophore is minute and subumbonal; the dentition is moderately strong, the anterior series including 12 to 15 A-shaped teeth, the posterior series about 18 similar teeth. The muscle scars are relatively large and irregular in outline. The pallial line is obscure, the sinus short, narrow, and acute.

The lower Rio Grande Embayment of the mid-Eocene must have been an extensive mud flat on which burrowing forms such as *Adrana aldrichiana* and *Orthoyoldia psammotaea* flourished. The Mexican collections are much more limited than those from Texas, but there is no reason to believe that this was true of the fauna.

DISTRIBUTION: Laredo formation: middle Laredo, U.S.G.S. sta. 13990 (H-9); upper Laredo, ?U.S.G.S. sta. 13983 (G-4). Yegua formation: U.S.G.S. sta. 13736 (J-6); U.S.G.S. sta. 13749 (K-7); U.S.G.S. sta. 13735 (K-7).

### *Incertae sedis*

Nuculanids of a *Yoldia*-like aspect are fairly common in the indurated sandstones north of La Laja. The beaks are a little in front of the median line, the anterior end is broad, the posterior portion is not keeled but slightly constricted in front of the beaks and produced to a blunt, broadly rounded extremity.

The material is in the form of internal molds 3 to 4 millimeters high and 6 to 8 millimeters wide, from the lower part of the Indio formation at U.S.G.S. sta. 13669 (E-12).

### Superfamily ARCEA

### Family GLYCYMERIDAE

### Genus *Glycymeris* DaCosta

1778. *Glycymeris* DaCosta, Historia naturalis testaceorum brittaniae or The British Conchology, p. 168.

TYPE, BY SUBSEQUENT DESIGNATION (DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 607, 1898): *Glycymeris orbicularis* DaCosta = *Arca glycymeris* Linnaeus. Recent off the British Isles and the coast of Europe.

Shell heavy, equivalve, equilateral or subequilateral, suborbicular; the anterior extremity usually the more produced and rounded. Beaks almost straight, only slightly incurved. Outer surface concentrically or radially striate or sulcate. Ligament amphidetic, multivincular, the ligament fur-



rows arranged in concentric rhombs. Hinge margin arcuate, set with two series of strong transverse teeth, chevron-shaped medially, the distal teeth oblique to horizontal; teeth progressively obliterated during growth by the subsidence of the ligament area. Adductor scars distinct, the posterior buttressed. Pallial line simple or very slightly sinuous. Inner margins crenulate in harmony with the outer ribbing.

The genus is first recognized in the Cretaceous; it culminated in the mid-Tertiary and is represented in the Recent seas by about 80 species, widely distributed in the shallower waters of the warm and temperate seas.

*Glycymeris* sp. cf. *G. mississippiensis* (Conrad)

(Plate 10, figure 17)

Synonymy and description of *Glycymeris mississippiensis* (Conrad):

1848. *Pectunculus mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 125, pl. 13, fig. 25.  
 1898. *Glycymeris mississippiensis* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 608.

"Orbicular, ventricose; length and height equal; disk with slightly prominent fine radii, minutely crenulated; series of teeth uninterrupted; inner margin finely crenulated." Conrad, 1848.

TYPE LOCALITY: Vicksburg, Mississippi.

A small but rather heavy shell in the Oligocene of Mexico is ornamented with a very fine, reticulate sculpture suggesting *Limopsis*. The hinge area is not well preserved, but there is no indication of a subumbonal ligament pit, and the series of a dozen or more coarse teeth is uninterrupted. Conrad's Vicksburg species is exceedingly rare in our collections, too rare to afford the means of determining the specific limits; the Mexican shell is similar to a valve collected at U.S.G.S. sta. 7671, Brown's Cave, Leaf River, Smith County, Mississippi, and may well fall within the range of variation. The general aspect of *mississippiensis* suggests in miniature *Glycymeris staminea* (Conrad) of the late Eocene and *Glycymeris americana* (de France) of the Miocene to Recent faunas.

The figured right valve (U. S. Nat. Mus. 495921) probably measured when complete about 10 millimeters in height and 9.5 millimeters in width. It is from the lower marine Oligocene sandstone at U.S.G.S. sta. 13518, Nuevo León, Mexico. The form has not been recognized elsewhere.

Family ARCIDAE

Subfamily NOETINAE

Genus *Halonanus* Stewart

1930. *Halonanus* STEWART, Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, p. 78.

TYPE, BY ORIGINAL DESIGNATION: *Noetia pulchra* Gabb. Lower Claiborne (Eocene) of the Western Gulf.

Shell small, equivalved, inequilateral, not gaping. Outline transversely ovate to rounded-trigonal. Umbones small, subacute, opisthogyrate, submedial or slightly posterior. Anterior extremity broadly rounded. Posterior portion of shell more or less sharply rostrate, the rostral angle well defined toward the umbones but flattening toward the ventral margin. External surface smooth or feebly sculptured concentrically or radially or both. Ligament multivincular, vertically striate, elongate-cuneate, the base of the triangle beneath and a little in front of the tips of the umbones; the ventral margin of the area horizontal, the dorsal coincident with the dorsal margin of the valve. Anterior and posterior dental series discrepant, arranged in a broad arc, the medial teeth crowded and chevron-shaped, the distal short and oblique. Muscle impressions relatively large and prominent, feebly buttressed. Pallial line simple. Inner margins not crenate.

*Halonanus pulchrus* (Gabb)

(Plate 1, figures ? 2, ? 4; Plate 7, figure ? 13)

1860. *Noetia pulchra* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 388, pl. 67, figs. 55, 55a.  
 1919. *Trinacria pulchra* Gabb. HARRIS, Bull. Am. Paleontology, vol. 6, p. 40, pl. 18, figs. 11-14.  
 1931. *Trinacria pulchra* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 104, 108.



"Subquadrangular; beaks small, incurved; umbonal slope nearly straight; anterior margin rounded, basal arcuate; posterior subangular; surface marked by numerous radiating and transverse lines; edge crenate within; posterior muscular scar subtriangular, anterior subrhomboidal.

"Dimensions.—Length .27 in., width .35 in." Gabb, 1860.

TYPE LOCALITY: Caldwell County, Texas.

TYPE: Academy of Natural Sciences of Philadelphia.

In northeastern Mexico and in south Texas, the species is replaced by *Halonanus declivis* (Conrad), but there are a few strays, including the figured specimen, which may represent the genotype. The figured specimen (U. S. Nat. Mus. 496022) from Carlos Cantú is a worn individual, relatively higher, perhaps, than the average Brazos River form, and with a more decided radial threading. This sculpture may, however, have been brought out by weathering. The height is 7.4 millimeters; the width at the ventral margin, 10.4 millimeters; the convexity of the double valves, 5.3 millimeters. It was collected from the lower Laredo formation at U.S.G.S. sta. 13600 (H-15).

DISTRIBUTION: Laredo formation: lower Laredo, ?U.S.G.S. sta. 13600 (H-15); ?U.S.G.S. sta. 13617 (H-18); ?U.S.G.S. sta. 13618 (H-17).

### *Halonanus declivis* (Conrad)

(Plate 1, figure ? 11)

1833. *Pectunculus declivis* CONRAD, Fossil shells of the Tertiary formations of North America, p. 39.  
 1860. *Limopsis declivis* CONRAD, Acad. Nat. Sci. Philadelphia, 2d ser., vol. 4, p. 297, pl. 47, fig. 13.  
 1890. *Limopsis declivis* CONRAD. DE GREGORIO, Annales Géologie Paléontologie, vol. 8, p. 191, pl. 23, figs. 21–24.  
 1898. *Trigonarca declivis* CONRAD. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 606.  
 1919. *Trinacria declivis* CONRAD. HARRIS, Bull. Am. Paleontology, vol. 6, p. 42, pl. 19, figs. 3–6.  
 1931. *Trinacria declivis* CONRAD. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 104.

"Shell ovate acute, rather compressed, with fine concentric crowded lines, and very minute and obscure radiating lines, which become very distinct on the posterior side, near the extremity; posterior side cuneiform; beaks small, pointed and recurved; series of cardinal teeth interrupted under the beaks; margin entire. Length  $\frac{3}{4}$  of an inch." Conrad, 1833.

TYPE LOCALITY: Blue clays just above the "Upper Landing" at Claiborne, Ala.

The figured imperfect right valve, U. S. Nat. Mus. 495923, from U.S.G.S. sta. 13861, Tamaulipas, Mexico, is 7 millimeters high and possibly 8.5 millimeters wide.

The individuals from the western Gulf referred to this species are imperfectly preserved, but aside from the lower dimensions, they are similar to *T. declivis* from the Lisbon formation of Alabama.

The species is decidedly larger than *Halonanus pulchrus*, abundant in the Weches formation of East Texas, rectangular rather than trigonal, more compressed than *pulchrus*, with less prominent beaks and with uniformly feeble concentric sculpture and radials developed only in the rostral area. In the western Gulf, *Halonanus declivis* is restricted apparently to the Rio Grande Embayment and nowhere common.

In the Alabama River section, it characterizes the upper part of the Lisbon formation, a stratigraphic horizon higher than that maintained by *Halonanus pulchrus* (Gabb) and roughly analagous, possibly to that which it holds in the west.

DISTRIBUTION: Laredo formation: middle Laredo, ?U.S.G.S. sta. 13861 (H-4).

### Subfamily ARCINAE

Aug., 1935. P. W. REINHART, Mus. royal histoire nat. Belgique Bull., t. 11, no. 13, pp. 1–68, pls. 1–5.

### Genus *Barbatia* Gray

1840. *Barbatia* GRAY, Synopsis of the contents of the British Museum, 42d ed., 151 (nomen nudum).  
 1842. *Barbatia* GRAY, Synopsis of the contents of the British Museum, 44th ed., p. 81. Genus without species.  
 1847. *Barbatia* GRAY, Zool. Soc. London, Proc. pt. 15, p. 197.

TYPE, BY SUBSEQUENT DESIGNATION (GRAY, 1847): *Arca barbata* Linnaeus. Recent in the Mediterranean.

"The *Barbatia* are elongated shells, covered with a hairy periostraca; the teeth on the middle of the line are small, of the ends large and oblique." Gray, 1842.



The shell of *Barbatia*, like that of *Arca*, is usually of at least moderate dimensions, inequilateral, transversely elongate, with a byssal gape at the ventral margin, anterior or subcentral beaks, a multi-vincular ligament, numerous taxodont teeth, rather large muscle scars, a simple pallial line, and, as a rule, a crenate inner margin.

The shell is usually less deformed in *Barbatia* than it is in *Arca*, the byssal gape is not so wide, the posterior portion of the shell is broadly rounded rather than rostrate, and the beaks are less prominent and the cardinal area consequently lower, the dentition is less regular than that of *Arca* and is usually obliterated medially in the adult by the encroachment of the cardinal area. The shells of both genera are radially sculptured, but that of *Barbatia*, though irregular in many species, is less sharply differentiated on the anterior and posterior areas.

True *Barbatia* has been recognized in the Upper Cretaceous of the east coast and Gulf (Stephenson, 1923; Wade, 1926), and the genotype is a Recent species.

*Barbatia* sp. cf. *B. ludoviciana* (Harris)

Synonymy and description of *Barbatia ludoviciana* (Harris):

- 1899. *Barbatia cuculoides* (Conrad) var. HARRIS, Geology of Louisiana, Spec. Rept. 6, p. 301, pl. 53, fig. 3.
- 1916. *Arca cuculoides* Conrad (part). SHELDON, Palaeontographica Americana, vol. 1, p. 13, figs. excluded.
- 1919. *Arca (cuculoides?)* var. *ludoviciana* HARRIS, Bull. Am. Paleontology, vol. 6, p. 54, pl. 22, figs. 8-16.
- 1931. *Arca (Barbatia) cuculoides* Conrad var. *ludoviciana* Harris. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 104.

"Our new variety *ludoviciana* does not have the ribbing on the different parts of the shell perhaps so markedly differentiated as in typical *cuculoides* nor is there the umbonal carination so depended upon by Sheldon for identification of the species. Yet there is a tendency to the same type of ribbing and in a few small specimens the post-umbonal slope is sharply differentiated from the remainder of the shell. This early form seems to have some features in common with both *cuculoides* and *mississippiensis*." Harris, 1919.

TYPE: Cornell University, Ithaca, N. Y.

TYPE LOCALITY: Sabine River, probably from Pendleton, Texas. Wilcox group, probably the equivalent of the Tuscaloosa formation.

The lower Claiborne representatives from Texas are members of a group widely distributed through the Eocene and Oligocene of the eastern and western Gulf. The transversely elongate shells are conspicuously warped by the byssal gape; rounded at the ends and not greatly inflated; radially lirate, the lirae coarser and more distantly spaced posteriorly, finest and most crowded medially with pronounced resting stages near the ventral margin of the adult. The rather low cardinal area is deeply scarred with crowded but regularly spaced ligament grooves. The teeth are narrow and vertical medially but obliterated in the adult by the subsidence of the cardinal area, leaving only the oblique, coarse, and distant distal teeth. The inner margins are almost smooth and at the byssal gape are entirely so.

A fragment of a left valve which cannot be separated from *Barbatia ludoviciana* (Harris) was collected in the indurated sandstone 1 mile east of Agualeguas on the San Javier road, Nuevo León (U.S.G.S. sta. 13657 (B-5)). The fauna from this locality is much too meager to offer an adequate basis for correlation, but observations both in the field and in the laboratory support the suggestion advanced by Kane and Gierhart (1935) that the sandstone may be an outlier of a Wilcox overlap.

Section *Acar* Gray

- 1857. *Acar* Gray, Annals Mag. Nat. History, ser. 2, vol. 19, p. 369.

TYPE, BY SUBSEQUENT DESIGNATION (Woodring, Carnegie Inst. Washington Pub. 366, p. 36, 1925): *Arca gradata* Broderip and Sowerby. Recent on the Pacific coast of Mexico and Central America.

Shell small, solid, inequilateral, transversely elongated, rectangular or trapezoidal, rostrate behind. Surface normally cancellate. Ligament area rhomboidal and, for the most part, opisthodontic, more restricted anteriorly than the cardinal area. Dentition similar to that of *Barbatia s.s.*

The coarsely reticulate and roughened sculpture is the most ready diagnostic of the section *Acar*.



*Barbatia* sp. cf. *B. domingensis* (Lamarck)

Synonymy and description of *Barbatia domingensis* (Lamarck):

1819. *Arca domingensis* LAMARCK, Histoire nat. des animaux sans vertèbres, vol. 6, p. 40.  
 1874. *Arca squamosa* GUPPY (not Lamarck), Geol. Mag., decade 2, vol. 1, p. 443 (list).  
 1886. *Arca reticulata* Chemnitz. DALL, Bull. Mus. Comp. Zool., Harvard College, vol. 12, p. 242.  
     Not *Arca reticulata* Chemnitz, 1784.  
 1889. *Arca reticulata* DALL (not Gmelin), U. S. Nat. Mus., Bull. 37, p. 42. Not *Arca reticulata* Gmelin, 1792.  
 1898. *Barbatia* (Acar) *reticulata* DALL (not Gmelin), Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 629.  
 1901. *Arca reticulata* Gmelin. DALL AND SIMPSON, U. S. Fish Comm., Bull. for 1900, vol. 1, p. 460.  
 1915. *Barbatia* (Acar) *reticulata* DALL (not Gmelin), U. S. Nat. Mus., Bull. 90, p. 120.  
 1916. *Arca reticulata* Gmelin. SHELDON, Palaeontographica Americana, vol. 1, p. 20, pl. 4, figs. 8-12.  
 1917. *Barbatia* (Acar) *reticulata* Gmelin. MAURY, Bull. Am. Paleontology, vol. 5, p. 330, pl. 30, fig. 16.  
 1919. *Arca* (Acar) *reticulata* Gmelin. HARRIS, Bull. Am. Paleontology, vol. 6, p. 55, pl. 22, figs. 18, 19. (Part)  
 1920. *Barbatia* (Acar) *reticulata* Gmelin. MAURY, New York Acad. Sci., Scientific Survey of Puerto Rico and the Virgin Islands, vol. 3, pt. 1, p. 7.  
 1921. *Barbatia* (Acar) *reticulata* Gmelin. HUBBARD, New York Acad. Sci., Scientific Survey of Puerto Rico and the Virgin Islands, vol. 3, pt. 2, p. 106.  
 1925. *Barbatia* (Acar) *domingensis* (Lamarck). WOODRING, Carnegie Inst. Washington, Pub. 366, pp. 37-38, pl. 3, figs. 17, 18.  
 1931. ? *Arca reticulata* Gmelin. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 104.

A fragment of shell from the upper part of the Indio formation (U.S.G.S. sta. 13475, E-5), 1.5 kilometers east of Queriza on the Cerralvo-Mier road, Nuevo León, exhibits the characteristic coarse reticulate sculpture of the Recent West Indian species. *Barbatia domingensis* has been reported from a number of horizons and localities in the Eocene of the Gulf, but adequately preserved material would probably show differences of specific rank.

Genus *Anadara* Gray

1847. *Anadara* GRAY, Zool. Soc. London, Proc., pt. 15, p. 198.  
 1925. *Diluvarca* WOODRING, Carnegie Inst. Washington, Pub. 366, p. 40.  
     *Diluvarca* suppressed in favor of *Anadara* by WOODRING, Carnegie Inst. Washington, Pub. 385, p. 18, 1928.

TYPE, BY MONOTYPY (*Arca rhomboides* Blainville, the only other species cited, is a nomen nudum): *Arca antiquata* Linnaeus. Habitat not determined.

*Anadara* is a moderately heavy, transversely elongate shell with a rather wide range in size. The outline and the sculpture are more regular than in *Barbatia*. The byssal gape is less pronounced and does not warp the shell. The beaks are full, the cardinal area relatively high and scarred with concentric chevronlike ligament grooves diverging beneath the tips of the umbones. The dental series is not broken medially as it is in the adult *Barbatia*, but the distal teeth are larger than the medial, more oblique, and less closely spaced. In the larger shells, the muscle scars are prominent, and the inner margins deeply fluted.

The group includes a great number of our Tertiary and Recent East Coast and Gulf species.

*Anadara* sp.

A single mold of a rather large ark with very high and prominent beaks is included in the collection from the Guajalote formation at U.S.G.S. sta. 13586 (V-29), 11,500 meters N. 30° W. of San Fernando, Tamaulipas. The outline and the sparse ribbing recall *Arca chiriquiensis* Gabb (Acad. Nat. Sci. Philadelphia, Proc. for 1860, p. 567, 1861). Similar forms occur at the west and south ends of La Llorona Dam, U.S.G.S. stas. 13572 and 13732 (T-16), Hacienda Rio Bravo, Reynosa, Tamaulipas, Mexico. Though the species cannot be determined, the records of a shell of the distinctive outline and sculpture of *A. chiriquiensis* are interesting.

*Anadara* sp. cf. *A. santarosana* (Dall)

Molds allied to *Anadara santarosana* (Dall) and possibly referable to more than one species are common in the yellow limestones of the Guajalote formation in the vicinity of San Fernando, Tamauli-



pas, at U.S.G.S. stas. 13584, 13586, and 14048 (V-29) and beds at U.S.G.S. sta. 13455 (W-29). Similar molds have been noted also north of Mendez, Neuvo León, and along the scarp between Las Anacuas and Santa Cruz, San Fernando, Tamaulipas, at U.S.G.S. sta. 13574 (U-23). The group is large, the species closely related, and specific identification dubious in any but well-preserved material. *Anadara santarosana* from Oak Grove and the subspecies *geraetera* from the Chipola horizon are appreciably smaller than *Anadara waltonia* (Gardner) from the Shoal River, a species which in outline and in the height of the cardinal area recalls *Anadara chiriquiensis* (Gabb).

*Anadara* sp. cf. *A. vaughani* (Casey)

Synonymy and description of *Anadara vaughani* (Casey):

1896. *Arca rhomboidella* Lea var. VAUGHAN, U. S. Geol. Survey, Bull. 142, p. 46, pl. 3, fig. 8.  
 1903. *Arca vaughani* CASEY, Acad. Nat. Sci. Philadelphia, Proc., p. 265.  
 1916. *Arca vaughani* Casey. SHELDON, Palaeontographica Americana, vol. 1, p. 31, pl. 7, fig. 11.  
 1919. *Arca vaughani* Casey. HARRIS, Bull. Am. Paleontology, vol. 6, p. 53, pl. 22, figs. 5, 6, 7.

"While mentioning the genus *Arca*, it may be appropriate to allude to a species, quite common in the Lower Claiborne at St. Maurice, La., and allied somewhat to *rhomboidella* Lea. It attained a length of more than 20 mm., with a height of 12 mm. or more, obliquely rhomboidal, moderately inequilateral, rounded anteriorly and posteriorly and broadly rounded ventrally. It is moderately inflated, the radiating concavity at the middle of the umbones almost obsolete and having merely slightly wider intervals between the ribs, the latter 41-43 in number. The hinge-line is long and straight, the teeth becoming larger and very oblique laterally but well developed throughout, with their sides finely ribbed, giving to each tooth a bipectinate appearance. The area under the beaks is ample and broadly divaricately striate. This species differs from *rhomboidella* in its much larger size, more numerous ribs, rounded ventral edge and many other characters, and may be named *vaughani*. A fair illustration of it was given by Mr. Vaughan (Geol. Survey, Bull. 142, Pl. III, fig. 8), in whose honor it is named. A modification of the true *rhomboidella*, but still smaller in size, also occurs sparingly at St. Maurice." Casey, 1903.

DIMENSIONS OF HOLOTYPE: Height, 9.3 millimeters; length, 14.8 millimeters; convexity of single valve, 4.0 millimeters.

HOLOTYPE, a single, rather badly worn left valve: U. S. Nat. Mus. 480107.

TYPE LOCALITY: St. Maurice, Louisiana.

The specimen measured is that marked "Type" in Casey's handwriting in his collection, which is now deposited in the U. S. National Museum. There are only a few specimens included, all of them left valves, and none of them greatly exceeds the dimensions of his "Type." His observation on the lower dimensions of *rhomboidella* is confusing, for the average adult *rhomboidella*, as Harris said, "is about 20 millimeters in length, though some specimens may reach 35 millimeters." The two species differ, however, in outline, for *rhomboidella* is a rather strikingly quadrate shell with subparallel dorsal and ventral margins and a rather square anterior end. In *vaughani*, on the contrary, the anterior extremity is obliquely rounded into the ventral margin, the ribbing is more simple and regular, and the shell is not so wide relatively.

The "*Arca rhomboidella*" group of Isaac Lea, 1833, is probably represented in a number of lower Claiborne collections from northern Mexico, but the material is not good, and the specific characters not determinable. A species of *Anadara*, probably of the *A. rhomboidella* group, is abundant in the lower part of the Mount Selman formation but is too poorly preserved to determine. Much of the material is shell breccia, and the shells were broken before deposition. The form resembles *A. deussenii* from the Mount Selman of Texas in outline, but the ribs are less numerous. A small species, also known from molds only, is common in the middle part of the Laredo formation at U.S.G.S. sta. 13641 (M-25). Another small ark from a slightly higher horizon U.S.G.S. sta. 13544 (J-15) may be allied to *A. vaughani*, but the rib count is lower. Possibly the relationship is closer to *A. rhomboidella parsaba* Harris.

The group of *Anadara rhomboidella* is indicated in the Jackson formation by small, transversely elongate, quadrate molds with about 30 regular but not uniform radials, recovered from the lower or middle Jackson at U.S.G.S. sta. 13504 (M-8) and from the upper Jackson at U.S.G.S. sta. 13513 (M-11).

DISTRIBUTION: Laredo formation: middle Laredo, ?U.S.G.S. sta. 13772 (G-3); upper Laredo, U.S.G.S. sta. 13768 (G-3); U.S.G.S. sta. 13861 (H-4).



## Superfamily MYTILACEA

## Family MYTILIDAE

Genus *Brachidontes* Swainson

1840. *Brachidontes*, SWAINSON, Treatise on malacology, p. 384.

1905. *Brachyodontes*, JUKES-BROWNE, Malacol. Soc. London, Proc., vol. 6, p. 222.

TYPE, BY MONOTYPY: *Modiola sulcata* Lamarck. Recent in the Indian Ocean.

*Brachidontes* has been commonly considered as a subgenus or section of *Modiolus* signalized by a radially sulcate sculpture. It was given generic status by Jukes-Browne because of the crenulate posterior margin, an important embryonic character retained in the adults of this group. Another constant feature of the genus as defined and restricted by Jukes-Browne is the musculature, indicated by a small but distinct anterior adductor scar, and a much larger posterior adductor, to which is united the scars of the median and posterior byssal retractors. The hinge line is for the most part straight, and its union with the posterior lateral margin angular. The ligament is short and marginal or submarginal. The position of the umbones varies with the development of the anterior portion of the shell, and although the external surface is characteristically sculptured with a fine bifurcate ribbing a few species are wrinkled or smooth.

*Brachidontes* is the well-represented group of the Mytilacea in the Eocene of the Western Gulf.

*Brachidontes* sp. cf. *Brachidontes texanus* (Gabb)

A very fine species of *Brachidontes* is represented in collections from U.S.G.S. sta. 13604 (G-16) in Arroyo La Laja east of China, Carlos Cantú, Nuevo León. Though relatively broad, in general form and dimensions the valve recalls *B. texanus* (Gabb) and may fall within the range of variation of that species. The ribs are wider, however, than in the type and do not show so strong a tendency to bifurcate on the ventral and posterior slopes. The horizon is probably in the middle Mount Selman formation and lower than any from which the species is recorded either in Texas or in Mexico.

*Brachidontes mississippiensis* (Conrad)

Jan. 1848. *Modiola Mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 3, p. 295.

Aug. 1848. *Modiola mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 126, pl. 12, fig. 19.

1898. *Modiolus (Brachyodontes) mississippiensis* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 796.

"Slightly arched, elongated, ventricose, with rather fine closely-arranged radiating lines wanting on the anterior side; region of umbonial slope inflated; posterior end acutely rounded; beak angulated posteriorly; substance of shell silvery and perlaceous. 2-10ths from beak to base. Rare, except in one spot, where I obtained several fragments and specimens." Conrad, 1848.

The rostral area and that behind it are covered with a close flat radial lineation. In front of the rostral area, the radial sculpture abruptly ceases, and only the incremental sculpture remains. On the short narrow anterior lobe in front of the beaks, a few short radial lirae are developed. They are strongest toward the front and evanesce away from the lateral margin.

TYPE LOCALITY: Vicksburg, Mississippi.

The species exhibits the characteristic sculpture of *Musculus*, but it far exceeds the dimensions of that small form. The rostral fold is acute near the umbones but broadens and flattens toward the ventral margin. The Mexican specimens seem a little more strongly warped than those from Mississippi, but otherwise they are not distinguishable from specimens, presumably topotypes, of *mississippiensis*. Such forms, one of them 10 millimeters high and almost 30 millimeters wide, are locally common but poorly preserved. A closely related, possibly identical species occurs in the upper Jackson at U.S.G.S. sta. 13515 (M-12).

DISTRIBUTION: Lower and middle marine Oligocene sandstone: U.S.G.S. sta. 13510 (M-11); U.S.G.S. sta. 13535 (N-17).

Genus *Musculus* (Bolten) Roeding

1798. *Musculus* (Bolten) ROEDING, Museum Boltenianum, pt. 2, p. 156.

1840. *Modiolaria* BECK, in ROBERT, Zoologie d'un voyage de recherche en Islande et en Grönlande p. xxviii, pl. 17, figs. 1-4.



TYPE, BY SUBSEQUENT DESIGNATION (IREDALE, Jour. Conchology, vol. 14, p. 342, 1915): *Musculus discors* Roeding = *Mytilus discors* Linnaeus. Recent off the coast of Greenland and northern Europe.

*Musculus* has been generally accepted as a group closely allied to *Modiolus* but separated from it by the absence of radial sculpture upon a certain well-defined anterior area. Jukes-Browne considers this sculpture pattern of little taxonomic importance but concedes to the group generic rank because of the crenulation of the hinge line behind the ligament and the long anal siphon and foot. In some species, at least, of *Musculus* the posterior adductor scar is smaller than the anterior, and the byssal retractors are not merged with the posterior adductor.

*Musculus carlotae* Gardner, n. sp.

(Plate 5, figures 3, 6)

Shell with the characteristic outline of the genus; rather small. A pronounced ridge, most elevated and narrow in the umbonal area separating the flaring posterior portion from the narrower and flattened anterior area. Posterior area and the flanks of the umbonal ridge crowded with close-set radials, for the most part fairly regular in strength and arrangement, rarely diastomosing. Medial anterior area slightly concave, sculptured only with regular concentric striae; several radials more widely spaced than those on the posterior area near the ventral margin of the anterior end. Characters of interior not known.

DIMENSIONS OF HOLOTYPE: Length along the umbonal ridge, 13.5 millimeters; width, 6.5 millimeters.

HOLOTYPE: A mold of the exterior of the left valve, U. S. Nat. Mus. 494975; and paratype, also a left valve, U. S. Nat. Mus. 494968.

TYPE LOCALITY: Holotype, U.S.G.S. sta. 13450 (D-19); and paratype, U.S.G.S. sta. 13462 (E-18). The horizon is probably of upper Midway age, though it may be a little younger.

*Musculus carlotae*, named in honor of the tragic figure who reigned for a few short months with Maximilian, is extremely close to the species described by Harris from the Woods Bluff horizon at Choctaw Corner, Ala., under the name of *Modiola alabamensis* (Bull. Am. Paleontology, vol. 1, p. 68, pl. 5, fig. 13). The sculpture patterns are apparently identical. Harris gives no measurements, but if his figure is natural size the Alabama form is more than twice as large as the Mexican. In any case, the Harris species must be renamed, for it is a *Musculus*, not a *Modiolus*, and the name *alabamensis* was preoccupied by Meyer in 1886 (*Modiolaria* [= *Musculus*] *alabamensis* Meyer [*alabamiensis* in plate description], Geol. Survey Alabama, Bull. 1, pt. 2, p. 83, pl. 3, fig. 19, 1886).

DISTRIBUTION: Midway group: ?upper Midway, U.S.G.S. sta. 13462 (E-18); U.S.G.S. sta. 13450 (D-19).

*Musculus* sp.

Fragments showing the characteristic sculpture of *Musculus* are common in beds below the *Ostrea lisbonensis* zone at U.S.G.S. sta. 13626 (L-24), in Santa Ana, China, Nuevo León. The species may be related to the imperfectly understood *Musculus alabamensis* of Meyer which was described from a juvenile from the "lowest Claiborne" of Claiborne, Alabama.

Similarly sculptured individuals measuring more than 2 centimeters along the keel were recovered from the foraminiferal series above the *O. lisbonensis* zone. They are characterized by an unusually sharp concentric sculpture on the anterior area and along the keel, flat radials, which become higher and sharper toward the ventral and posterior lateral margins. Other members of the genus, though probably not specifically identical with that from Santa Ana, occur in the middle Laredo formation at U.S.G.S. stas. 13566 (H-12) and 13593 (I-13).

Genus *Lithophaga* (Bolten) Roeding

1798. *Lithophaga* (Bolten) ROEDING, Museum Boltenianum, pt. 2, p. 156.

TYPE, BY MONOTYPY: *Mytilus lithophagus* Linnaeus = *Lithodomus dactylus* Sowerby. Recent in the Mediterranean.

Shell thin, nacreous, equivalve, strongly inequilateral, subcylindrical. Umbones at or near the rounded anterior extremity. Posterior extremity rostrate or cuneiform. Outer surface smooth or feebly wrinkled concentrically. Ligament inframarginal. Hinge edentulous. Muscle impressions



indistinct, the anterior adductor oval and relatively large for the group; the posterior adductor oval and only a little larger than the anterior.

The genus has been reported from the Paleozoic. The Recent species number less than 50 and are restricted to tropical and warm temperate waters.

The young are attached by a byssus but in the later stages usually perforate coral colonies, the shells of larger bivalves, or solid rock. Two of the subgenera are incrustated in the adult stages with a dense calcareous covering. The cavities which they excavate are characteristically flask-shaped. The perforations in the columns of the temple of Serapis that served Lyell for his classic illustration of changes in the level of the sea were made by *Lithophagae*.

*Lithophaga* sp.

(Plate 1, figures 1, 5)

A mold from the lower marine Oligocene sandstone of Mexico resembles *Lithophaga claibornensis* Conrad in general aspect. The specimen is subcylindrical, suggesting a date seed in size and shape; the anterior portion conforms very closely to the burrow, the posterior extremity is drawn out along an obtuse keel extending from the umbones to the posterior ventral margin. The umbones are nearly terminal and curve to conform to the burrow. The anterior extremity rounds smoothly into the base, with the suggestion of a slight overlap of the left valve upon the right. The ligament is marginal and straight, and the area about half as long as the shell. Behind the ligament the profile shows an even slope to the extremity of the obtuse rostrum. A few bits of the shell substance still adhere to the mold of the united valves.

DIMENSIONS OF FIGURED SPECIMEN: Diameter, 6.5 millimeters; length, 17.5 millimeters.

FIGURED SPECIMEN (the mold of the united valves): U. S. Nat. Mus. 495925.

Locality of figured specimen, U.S.G.S. sta. 13509 (M-11). Lower marine Oligocene sandstone. Only the single individual is known.

*Incertae sedis*

The inner mold of closed valves with fragments of a thin shell adhering was recovered from the indurated middle Laredo sands of U.S.G.S. sta. 13547 (I-14); it was associated with a diversified fauna. Ventrally and posteriorly, the outline suggests *Modiolus* or *Lithophaga*, but the beaks do not conform to the smooth flask-shaped outline characteristic of the species of those genera. The height of the mold is 15 millimeters, the width possibly 35 millimeters, the convexity 13 millimeters. The beaks fall, probably, within the anterior third and are evenly and moderately inflated. The short anterior end is symmetrically rounded. Behind the umbones, the shell is somewhat obliquely produced along an obtuse keel, vaguely traceable from the umbones to the ventral margin. The only apparent sculpture is the incremental wrinkling.

The form in question is U. S. Nat. Mus. 496120.

Superfamily PTERIACEA

Family PTERIIDAE

Genus *Pteria* Scopoli

1777. *Pteria* SCOPOLI, Introductio ad historiam naturalem, p. 397.

TYPE, BY MONOTYPY: *Mytilus hirundo* Linnaeus. Recent off the coast of England and southward through the Mediterranean.

Shell nacreous, inequivalve, the left valve the more inflated, inequilateral, auriculate. Anterior ear comparatively small, the posterior aliform. Byssal sinus under anterior auricle of right valve. Exterior surface almost smooth, lamellar or striated. Umbones low but sharp. Hinge line elongated, straight. A single cardinal set under the umbone of each valve, commonly supplemented by a laminar lateral tooth. Ligament marginal, partly internal, partly external. Adductor impression subcentral. Pallial line entire.

The genus is said to have a vast stratigraphic range—from the Silurian onward. The Recent species number about 120 and live chiefly in tropical and subtropical waters.



*Pteria* sp. cf. *P. deussenii* Gardner

Description of *Pteria deussenii* Gardner:

1935. *Pteria deussenii* GARDNER, Univ. Texas Bull. 3301, p. 134, pl. 7, fig. 8.

"Shell small, obliquely semi-elliptical in outline, the straight dorsal margin equalling in length the maximum latitude. Umbones very small, acute, terminal, set about a third of the way back from the anterior margin. Posterior area about twice as great as the anterior—neither of them sharply delimited. Outer surface decorticated, but apparently marked with a very strong growth sculpture. Interior not accessible.

"Dimensions.—Height, 4.5 millimeters; length, 4.5 millimeters.

"Holotype.—U. S. Nat. Mus. 370964.

"Type locality.—U. S. G. S. Sta. 6559, Comanche Crossing on Navasota Creek about 6 miles west of Mexia, Limestone County, Texas. Tehuacana member of Kincaid formation." Gardner, 1935.

Indeterminate fragments of *Pteria* are fairly common along the Rio San Juan. They indicate a species apparently larger and more obliquely elongated than *P. deussenii*, but the dorsal margins are less produced relatively.

DISTRIBUTION: Midway formation: ?upper Midway, U.S.G.S. sta. 13462 (E-18). Indio formation: lower Indio, U.S.G.S. sta. 13669 (E-12).

*Pteria limula* (Conrad)

(Plate 1, figure ? 12)

Oct., 1833. *Avicula limula* CONRAD, Fossil shells of the Tertiary formations of North America, p. 39.

Dec., 1833. *Avicula claibornensis* ISAAC LEA, Contributions to geology, p. 86, pl. 3, fig. 65.

1890. *Avicula claibornensis* Lea. DE GREGORIO, Annales Géologie Paléontologie, vol. 8, p. 183, pl. 22, fig. 4.

1890. *Avicula cardincrassa* DE GREGORIO, Annales Géologie Paléontologie, vol. 8, p. 184, pl. 22, figs. 1, 2.

1919. *Pteria limula* Conrad. HARRIS, Bull. Am. Paleontology, vol. 6, p. 29, pl. 16, figs. 3-7.

"Shell convex, with slight concentric undulations; umbo tapering gradually towards the apex, which is acute, but not prominent; wings large and very oblique; sinus of the posterior margin not profound; nacre very pearly and iridescent. Height, 1½ inches." Conrad, 1833.

TYPE LOCALITY: Claiborne, Alabama.

TYPE: Acad. Nat. Sci. Philadelphia.

The mold of a right valve (U. S. Nat. Mus. 495926) from U.S.G.S. sta. 13643 (M-25) is similar in outline and convexity to that from the Claiborne sand. In *Pteria limula* there is more than the usual difference in the degree of convexity of the two valves. Conrad's description was apparently based on a left valve. In the left valve, there is only a slight inflation, most pronounced in front of the oblique axis of the shell. Behind the axis, the disk flattens and merges into the ill-defined posterior wing. The anterior wing is relatively short and narrow and is cut off from the disk by an obtuse groove. The shell, unfortunately lost in the Mexican specimen, is corrugated concentrically. The interior shows obscure lirations radiating from the apex of the umbone. These are indicated on the mold from the Rancho Barretosa. The crude dentition is not preserved.

*Pteria limula* represents the genus in the upper Eocene. It is abundant in the Claiborne sand and common in the Jackson of Mississippi. Its distribution below the Claiborne sand is less certain. Preservation is, for the most part, inadequate, and departures from the type difficult to evaluate.

Harris characterized a left valve from Houston County as "thinner, and much more erect" than the Alabama race. These differences are to be noted in a valve from San Augustine, Texas, and may, possibly, with study of additional material, prove to be of systematic value.

DISTRIBUTION: Laredo formation: middle Laredo, ?U.S.G.S. sta. 13643. Jackson formation: lower or middle Jackson, U.S.G.S. sta. 13503 (N-8).

*Pteria* sp.

An indeterminate *Pteria* with a hinge spread of about 40 millimeters was recovered from a lower marine Oligocene sandstone carrying fossiliferous limestone concretions. The species may well be *Pteria argentea* (Conrad) (Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 126, 1848), described



from the Vicksburg of Mississippi, but the material is too poorly preserved for positive identification. The station at which the collection was made is U.S.G.S. sta. 14056 (M-12), a small arroyo north of the Monterrey-Reynosa highway, Zacate, Nuevo León.

The same species may be represented by fragments from U.S.G.S. sta. 14147 (O-22), Carlos Cantú, China, Nuevo León.

#### Family PINNIDAE

#### Genus *Atrina* Gray

1840. *Atrina* J. E. GRAY, Synopsis of the contents of the British Museum, 42d ed., p. 151, nomen nudum.

1842. *Atrina* J. E. GRAY, Synopsis of the contents of the British Museum, 44th ed., p. 83.

TYPE, BY MONOTYPY: *Pinna nigra* Chemnitz. Recent in the Indo-Pacific.

Gray characterized the genus in 1842 as follows:

"The *Pinna* have an elongated shell with a longitudinal crack filled with a cartilage in the middle of each valve, and *Atrina* are shorter shells without any such crack."

Shell thin, fragile, equivalve, gaping posteriorly and ventrally, cuneate. Byssal gape not wide but much produced. Umbones terminal, at the apex of the narrow wedge. Outer surface smooth or longitudinally ribbed and fluted, the crests with or without spines. Ligament lodged in a long, narrow marginal groove extending in many species more than half the length of the shell. Hinge edentulous. Interior nacreous. Anterior adductor scar small and subumbonal; the posterior large, set near the posterior extremity of the ligament groove; byssal scar also large, placed in front of the posterior adductor. Pallial line simple, obscure.

*Atrina* is separated from *Pinna*, to which it has been frequently referred as a subgenus, by the absence of the medial longitudinal sulcation. It is confined to the warmer waters and is never abundantly represented.

Both *Pinna* and *Atrina* are most commonly found buried at shallow or moderate depths in the fine sands and muds of the sheltered tropical or subtropical beaches. They are colonial and local in their Recent distribution and are restricted in their fossil occurrences to the finer sediments. The group is of ancient origin.

#### *Atrina gravida* (Harris)

1919. *Pinna gravida* HARRIS, Bull. Am. Paleontology, vol. 6, p. 30, pl. 16, figs. 8-11.

1931. *Pinna gravida* Harris. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 104.

"Shell moderate in length, but of extreme convexity, giving a cross-section half way from beak to posterior almost a circular form; nearer the beak the cross-section appears to be elliptical, wider than high. Markings on shell rarely of sufficient strength to show through on cast of interior (usually the only form in which the species is found). Rarely on imprints of exterior a few radiating raised costae are shown on the superior part of the shell, while commonly concentric undulations are seen near the basal portion. (Compare form with *P. vexillum* Born. Recent.)

"Type.—Deposited in Paleont. Mus. Cornell Univ.

"Horizon.—St. Maurice Eocene.

"Locality.—St. Maurice, La. Fragments of what appear to be of this species are abundant in the St. Maurice of Texas." Harris, 1919.

This species, like most thin-shelled forms, is susceptible to distortion.

A few fragmentary specimens with the sharp, decided, and rather meager sculpture indicated in the Harris figures have been recovered from the basal Laredo formation in Carlos Cantú, Nuevo León. The species seems to be rare. We have no certain examples in our Texas collections, but it is reported by Renick and Stenzel from the lower part of the Cook Mountain formation on the Little Brazos River, Texas.

DISTRIBUTION: Laredo formation; lower Laredo, U.S.G.S. sta. 13619 (H-17); U.S.G.S. sta. 13969 (I-19); middle Laredo, U.S.G.S. sta. 13547 (I-14).

#### *Atrina* sp.

An indeterminate species retaining the characteristic form and sculpture pattern of *Atrina* is included in the collection from the middle part of the Laredo formation at U.S.G.S. sta. 13643 (M-25).



*Atrina jacksoniana* Dall

(Plate 1, figures ? 10, ? 15)

1898. *Atrina jacksoniana* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 662.

"Shell thin, fragile, rapidly widening, somewhat compressed along the ventral border; sculpture of near the beaks numerous feeble, more or less wavy, longitudinal elevated lines, which become less distinct ventrally, and are obsolete over the greater portion of the shell, which appears from the numerous fragments to have been nearly smooth posteriorly, or with a few feeble concentric wavelets, most prominent ventrally. A fragment (including the beaks), forty-five millimeters long, has a dorso-ventral maximum diameter of thirty-four, and a transverse diameter of about twenty millimeters. The valves are evenly arched, and become more convex behind.

"The material is abundant but very fragmentary, yet sufficient to establish the identity of the species at these localities and its distinctness from the others mentioned." Dall, 1898.

The distribution of a large *Atrina* is to a remarkable degree coincident with the outcrop of the fossiliferous lower Jackson of the Gulf province exclusive of Mexico. All material in our collections is fragmentary. In the molds, the variation in the convexity is wide due in large measure to the warping of the soft muds in the process of consolidation. If only a single species is involved, there is a wide variation, too, in the number and spacing of the striations that parallel the dorsal margin. Dall reports *Atrina jacksoniana* from the lower Jackson at Moodys Branch and Garlands Creek near Shubuta, Mississippi, and from Creole Bluff, Louisiana. Our specimens from the upper Jackson of northeastern Nuevo León can be matched by specimens from Creole Bluff. Possibly ecology rather than time has governed the distribution of the species, or possibly our Mexican material is not adequate for determination. Dall's inclusion in his synonymy of the Lesueur figure from the Walnut Hills fossils is an error. The figure may represent *Atrina argentea* (Conrad) described from Vicksburg, the site of the old Walnut Hills fort, rather than *Atrina jacksoniana* Dall. A poorly preserved *Atrina* retaining no characters by which it can be separated from *jacksoniana* is one of the most common forms in the lower Jackson clays of east Texas.

Both specimens figured in this report are included under U. S. Nat. Mus. 495931 from the upper Jackson at U.S.G.S. sta. 13527 (M-11).

*Atrina* sp.

The genus is further represented by specifically indeterminate material from the lower marine sandstone probably of Vicksburg (Oligocene) age from U.S.G.S. sta. 13510 (M-11), southeast of Rancho La Copa, Hacienda Zacate, General Bravo, Nuevo León.

## Superfamily PECTINACEA

## Family PECTINIDAE

Genus *Pecten* Müller1776. *Pecten* MÜLLER, Zoologiae danicae prodromus seu animalium, p. 248.

TYPE, BY SUBSEQUENT DESIGNATION (SCHMIDT, C. F., Versuch über die beste Einricht., etc., pp. 67, 177, Gotha, 1818): *Ostrea maxima* Linnaeus. Recent in the north European seas.

Shell approximately equilateral, inequivalve, auriculate. Right valve usually the more convex, not adherent but attached by a byssus. Hinge line straight, the cardinal margin of the right auricles curved downward. Resilium central, internal, triangular; interlocking grooves and ridges diverging from the apex of the resilial pit. Pallial line simple. Monomyarian. Adductor impression rounded, posterior.

The earliest *Pecten* known is from the Cretaceous. The Recent species exceed 200, and their distribution is world wide.

Subgenus *Pecten*, s. s.1776. *Pecten* MÜLLER, Zoologiae danicae prodromus seu animalium, p. 248.

TYPE, BY SUBSEQUENT DESIGNATION (SCHMIDT, C. F., Versuch über die beste Einricht., etc., pp. 67, 177, Gotha, 1818): *Ostrea maxima* Linnaeus.



*Pecten*, s. s., is characterized by a rather strongly inflated right valve of at least moderate dimensions, a flattened left valve concave in the juveniles, a well-developed radial sculpture, rather large, obscurely lirate auricles, a shallow byssal notch, the absence of a ctenolium, and the development of more than one pair of cardinal crurae.

The Recent species, most closely related to *Pecten poulsoni* Morton, *Pecten raveneli* Dall, has been commonly referred to *Euvola* Dall, but the type of *Euvola*, *Ostrea ziczac* Linnaeus, is characterized in part by a feeble radial sculpture and a single pair of cardinal crurae.

*Pecten (Pecten) sp. cf. P. (P.) poulsoni* Morton

Synonymy and description of *Pecten (Pecten) poulsoni* Morton:

1829. — — LESUEUR, Walnut Hills fossil shells, pl. 5, figs. 3, 4.  
 1834. *Pecten poulsoni* MORTON, Synopsis of organic remains, p. 59, (part)?  
 1926. *Pecten poulsoni* Morton. COOKE, in Geol. Survey Alabama Spec. Rept. 14, pl. 97, figs. 1a, 1b.

"Suborbicular; superior valve flat; ribs fourteen, not profoundly elevated, with crowded wrinkled striae; inferior valve ventricose, with prominent rounded ribs, the intervals striated; ears subequal.

"Common in the newer cretaceous deposits near Claiborne, Alabama.

"I have much pleasure in naming this shell after my friend Charles A. Poulson, Esq., of this city." Morton, 1834.

The Oligocene limestones near Claiborne were included in the "newer Cretaceous" of Morton. The exact locality is not definitely known.

The name *poulsoni* is retained for *Pectens* with highly inflated right valves and relatively few simple ribs. The less inflated forms with more numerous decorated ribs are discussed under *Pecten byramensis*. Shells similar in outline and ornamentation to *Pecten poulsoni* are known from a single locality (U.S.G.S. sta. 14146, P-23), but possibly specific differences would be evident in better-preserved material. The fauna is of Vicksburg age, but the horizon has not been determined.

*Pecten (Pecten) byramensis* Gardner, n. sp.

(Plate 10, figures ? 1, ? 2, ? 3, ? 4)

1829. — — LESUEUR, Walnut Hills fossil shells, pl. 5, fig. 2?.  
 1834. *Pecten poulsoni* MORTON, Synopsis of organic remains, p. 59 (part)?  
 1834. *Pecten perplanus* MORTON, Synopsis of organic remains, p. 58, pl. 5, fig. 5?; pl. 15, fig. 8.  
 1898. *Pecten (Pecten) Poulsoni* Morton. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 719 (synonymy in part excluded).  
 Not *Pecten (Aequipekten) perplanus* Morton. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 732, 1898.  
 1917. *Pecten poulsoni* Morton. HOPKINS, U. S. Geol. Survey, Bull. 661-H, pl. 27, figs. 3, 3a.  
 1922. *Pecten poulsoni* Morton. COOKE, U. S. Geol. Survey, Prof. Paper 129-E, p. 84 (part).  
 1933. *Pecten perplanus* Morton. COOKE, Am. Assoc. Petrol. Geol., Bull., vol. 17, p. 1388.  
 1936. *Pecten (Pecten) poulsoni* Morton. TUCKER, Am. Mid. Nat., vol. 17, p. 476 (part), pl. 1, figs. 5, 6.

"Orbicular, somewhat flattened, with about twenty small, simple costae, transversely striated.

"Diameter, from three-fourths of an inch to an inch and a quarter.

"Occurs with the preceding species (*P. anatipes* Morton)." Morton, 1834.

The locality given by Morton for *Pecten anatipes* is "a mass of Nummulite limestone, from Claiborne, Alabama."

The exact locality from which the types of *poulsoni* and of *perplanus* were taken is not known.

Many of the figures of Lesueur and of Morton are inadequate reproductions and do not indicate the degree of convexity of the shell nor the ribbing pattern toward the distal extremities.

Cooke (1933) was the first to record the close relationship between *Pecten perplanus* Morton and *Pecten poulsoni* Morton. "The name *P. perplanus* was originally applied to the flat valve of *P. poulsoni* Morton, which is unknown in deposits older than the Vicksburg group, and therefore is a synonym of *Pecten poulsoni*."

The specimens from the Oligocene at U.S.G.S. sta. 13581 (P-25), Rancho Gigante, Escondido, Mendez, Tamaulipas, agree essentially with those figured by Hopkins, 1917, except for the flattening



toward the umbones, and are tentatively referred to that species. The right valve illustrated in Hopkins' report is from Pearl River, just above the bridge at Byram, Hinds County, Mississippi; the left is from the Byram marl as it is exposed at Vicksburg, Mississippi. The following descriptive notes are based upon the Byram and Vicksburg specimens as the cotypes.

The right valve is inflated and slightly wider than it is high; the left valve is flattened, and the apical angle  $115^{\circ}$  or more. About 18 ribs spring from the umbones of the right valve. They are narrow, rounded, regular in size and spacing at their inception and though they become increasingly broader and higher they remain simple for more than half the distance from the umbones to the ventral margin. A pronounced resting stage is indicated; dorsal to the break, the ribs are simple except for exceedingly faint and fine lirations upon the crests; ventral to it, a medial secondary follows the crest, and the edges of the ribs tend to be pinched so that at the ventral margin of the disk, in some individuals, there are 3 fairly well defined secondaries upon the summit of each primary. The channels between the radials are of approximately the same width as the radials and are evenly and sharply laminated by the incrementals.

The number of radials upon the left valve may be lower by one, the secondary sculpture is more obscure or absent altogether, and the concentric imbrication decidedly sharper. The submargins on both valves are narrow, steep, and barbed by the incrementals. The auricles are of moderate size. There is no sharply defined byssal notch or ctenolium but a slight constriction at the base of the right anterior auricle. The usual number of radials both on the right and the left anterior and posterior auricles is 5 or 4; they are distinct but by no means prominent and are overridden by the sharp and crowded growth laminae. The dorsal margins of the right valve are turned inward and are slightly higher than those of the left. There is a small trigonal subumbonal ligament pit and a marginal ligament groove extending the length of the dorsal margins. The two pairs of cardinal crurae as well as the strong radial sculpture ally both *Pecten poulsoni* and *Pecten byramensis* with *Pecten* (*Pecten*) rather than with *Pecten* (*Euvola*) Dall. The single muscle impression is large and is contained, for the most part, within the posterior dorsal quadrant. The ribbing pattern crenulates the margin and is reflected over the entire ventral portion of the inner surface. The specimens figured in the Hopkins' report are designated as the cotypes.

**DIMENSIONS OF COTYPES:** Right valve, height, 29.5 millimeters; width, 31.0 millimeters; convexity, 8.6 millimeters. Left valve of another individual, height, 26.7 millimeters; width, 28.7 millimeters; convexity, 3.9 millimeters.

**DIMENSIONS OF FIGURED SPECIMENS FROM TAMAULIPAS, MEXICO:** Right valve, height, 23.5 millimeters; width, 27.0 millimeters. Left valve of a larger individual, height, 30.0 millimeters; width, 32.2 millimeters.

Two left valves which may represent the young of *Pecten byramensis* are also figured. Larger of the two immature left valves: height, 18.0 millimeters; width, 19.5 millimeters. Smaller of the left valves: height, 15.6 millimeters; width, 15.7 millimeters.

**TYPE MATERIAL, TWO COTYPES:** Right valve, U. S. Nat. Mus. 370818; left valve, U. S. Nat. Mus. 370819. Figured specimens from Tamaulipas, Mexico: Right valve, U. S. Nat. Mus. 495927; left valve, U. S. Nat. Mus. 495927. Immature specimens: Larger left valve, U. S. Nat. Mus. 495928; smaller left valve, U. S. Nat. Mus. 495928.

**TYPE LOCALITY:** Right cotype, U.S.G.S. sta. 6454, Pearl River, just above the bridge at Byram, Hinds County, Mississippi; left cotype, U.S.G.S. Sta. 3729, top of bluff opposite second sawmill, slightly above second horizon, Vicksburg, Mississippi. Byram marl (Vicksburg group). Adult figured material: Right and left valves, U.S.G.S. sta. 13581 (P-25). Immature figured specimens, U.S.G.S. sta. 13535 (N-17).

*Pecten byramensis* differs from *Pecten poulsoni* in the lower convexity of the right valve, the higher rib count, and the development of a secondary liration on the adult primaries. Because of these constant differences and its later appearance in Vicksburg time, *Pecten byramensis* is considered closely related to *Pecten poulsoni* but distinct from it.

**DISTRIBUTION:** Upper Oligocene sandstone: ?U.S.G.S. sta. 13581 (P-25); and ?U.S.G.S. sta. 14034 (P-25).

Fragmentary examples from U.S.G.S. sta. 13535 (N-17) and from U.S.G.S. sta. 13532 (O-19) are closely related if not identical.



*Pecten (Pecten) sp. cf. P. (P.) macdonaldi* Olsson

(Plate 11, figures 1, 3)

The synonymy of *Pecten macdonaldi* Olsson is as follows:

1922. *Pecten MacDonaldi* OLSSON, Bull. Am. Paleontology, vol. 9, p. 370, pl. 16, figs. 1, 2.  
 1932. *Pecten (Pecten) macdonaldi* Olsson. MANSFIELD, Florida State Geol. Survey, Bull. 8, p. 57, pl. 14, figs. 5, 6.

Two left valves of a true *Pecten* occur in the San Fernando beds. They are very flat, the umbones sunk below the level of the slightly elevated dorsal margins of the disk. The submargins are wide for so flat a shell and sculptured with incrementals only. The ears are small, narrow, obscurely lirate, incrementally scabrous. The 20 radials are broadly and evenly rounded, abruptly rising from the flat interradiar areas. There are no defined crurae in the left valve. The muscle impression is small, sunken, and almost entirely within the antero-dorsal quadrant. The crenations of the inner ventral margins are deep, and the ribs in reverse are traceable more than half way up to the dorsal margins.

DIMENSIONS OF FIGURED LEFT VALVE: Height, 44 millimeters; width, 47 millimeters.

FIGURED SPECIMEN, A LEFT VALVE: U. S. Nat. Mus. 495022.

Both left valves are from the Guajalote formation at U.S.G.S. sta. 13588 (W-30), 620 meters N. 55° W. from the church tower in San Fernando, Tamaulipas.

Olsson's species is double the size of the Mexican shell and has about 6 more ribs. The closely related form figured by Mansfield from the lowest Choctawhatchee is 58 millimeters high and 60 millimeters wide. The number of ribs is the same as that of the Mexican valves, and the ears are similar, but the submargins are wider. The Mexican form is probably distinct from both the Costa Rican and the Floridian species, but the resemblance may indicate a genetic relationship.

Genus *Chlamys* (Bolten) Roeding

1798. *Chlamys* (Bolten) ROEDING, Museum Boltenianum, pt. 2, Conchylia, p. 161.

TYPE, BY SUBSEQUENT DESIGNATION (DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 695, 1898): *Pecten islandicus* Müller. Pleistocene of the boulder clays of the northeast coast and Recent from the Arctic to Chesapeake Bay.

Shell small or of moderate dimensions; inequilateral. Right valve slightly more compressed than the left. Dorsal margins steeply sloping. Sculpture radial, the lirae usually numerous and increasing by intercalation; imbricated by the concentric sculpture; persistent to the ventral margins which are scalloped by the ribbing. Anterior auricles larger than the posterior, the right anterior notched for the extrusion of the byssus. The margin below the byssal notch pectinated. The cardinal margin of the auricles of both valves bent inward over the inconspicuous ligament, those of the right valve the more forcibly. Resilium short and strong. Chondrophore small, trigonal, and subumbonal. Cardinal crurae not conspicuous. Characters of interior commonly obscure, usually with ribs and double flutings corresponding to the external ribbing.

*Chlamys* is widely distributed. Many species especially those living in the warmer waters, are active swimmers and very brightly colored.

*Chlamys burlesonensis* (Harris)

1891. *Pecten deshayesii* Lea. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, p. 403.  
 Not *Pecten deshayesii* Lea, 1833.  
 1898. *Pecten (Chlamys) clarkeanus* Aldrich. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 739 (part).  
 Not *Pecten clarkeanus* Aldrich, 1895.  
 1919. *Pecten (clarkeanus? var.) burlesonensis* HARRIS, Bull. Am. Paleontology, vol. 6, p. 26, pl. 14, figs. 11-13.  
 1931. *Pecten burlesonensis* Harris. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 108.

"Type.—Burleson Shell Bluff, Cornell University Museum.

"Horizon.—St. Maurice Eocene." Harris, 1919.

*Chlamys burlesonensis* (Harris) described from Burleson Bluff apparently includes a hybrid complex



of forms ranging broadly from the strongly ribbed *P. clarkeanus* Aldrich type to *Eburneopecten scintillatus* var. *corneoides* Harris. The more strongly and regularly sculptured forms may approach *Chlamys wahtubbeana* Dall (Pl. 10, fig. 24). The ribbing is perhaps the most obvious of the variable features. This may be decided and persistent from the umbones to the base. The umbones and the marginal area may be ribbed, while the intermediate surface may be smooth except for incremental and *Camptonectes*-like sculpture. Ribbing may be absent on the umbones but developed either abruptly or gradually at some distance away from them. Forms not fully developed may therefore be devoid of ribbing. The sculpture of the ears varies with that of the disk and is strongest on those forms in which ribbing is best developed. The *Camptonectes*-like sculpture is beautifully shown in fresh forms.

Although *Chlamys burlesonensis* exhibits so wide a range in number and complexity of ribs, in the aggregate of characters the species is well defined and readily discriminated. The shells are of medium size, about 20 millimeters high and almost 20 millimeters wide, but thinner than the average. The apical angle is about 90°. The disk is closely corrugated with rounded ribs which may or may not have their beginnings at the umbones. They may increase by intercalation or they may bifurcate toward the ventral margin. The submargins are narrow and not radially striate. The auricles are of moderate dimensions, and the 2 to 5 lirae which thread them are fine to rather coarse.

On the Brazos River in east-central Texas, *Chlamys burlesonensis* is characteristic of a 20-foot zone at the base of the Weches member of the Mt. Selman formation. In Nuevo León, the individuals referred tentatively to *burlesonensis* are associated with *Ostrea lisbonensis* near the top of the Mount Selman at U.S.G.S. sta. 13622 (L-23), U.S.G.S. sta. 13623 (L-24), and U.S.G.S. sta. 13635 (M-24).

Relatively large imperfect examples exhibiting more regular sculpture have been recovered from the glauconitic and calcareous sandstone below the *Ostrea lisbonensis* zone in Santa Ana, Nuevo León, U.S.G.S. sta. 13626 (L-24).

### *Chlamys capa* Gardner, n. sp.

(Plate 1, figures 6, 9)

Shell small, moderately compressed, subequivalved, subequilateral. Outline, exclusive of the auricles, an 80- to 90-degree segment of a circle. Ribbing fairly regular; 21 or 22 narrow rounded or obtusely  $\Lambda$ -shaped ribs persisting from the umbones to the ventral margin with little or no loss of strength as they approach the margin. Secondary sculpture imperfectly preserved; traces of a growth imbrication clearly visible, however, and obscure traces of a very faint and fine radial lineation on both the costal and the intercostal areas; no bifurcation or intercalation noted in available material, but a certain irregularity, commonly associated with intercalated ribbing, discernible in the prominence of the costals. Submargins narrow, smooth, except for incrementals. Auricles of average size; both the anterior and the posterior auricle of the right valve threaded with about 5 lirae, the lirae on the auricles of the left valve apparently less numerous by one. Characters of the interior not known.

**DIMENSIONS:** Right valve (cotype): height, 16.5 millimeters; width, 15.7 millimeters. Left valve of another individual (cotype): height, 16.0 millimeters; width, 17.0 millimeters.

**TYPE MATERIAL:** Two cotypes, U. S. Nat. Mus. 496267, the right and the left valves of two individuals.

**TYPE LOCALITY:** U.S.G.S. sta. 13642 (M-25). Middle part of Laredo formation.

The shell is firmly embedded in the matrix, and many of the characters obscured. The species may be related to the regularly sculptured *C. lyelli* (Lea) and *C. nupera* (Conrad), the former described from Claiborne, Alabama, the latter from Jackson, Mississippi.

An increase in the number of ribs by interpolation and bifurcating and their appearance at a late growth stage characterize the lower Claiborne forms in northeastern Mexico. The closely related subspecies *Chlamys capa jouda* from Zacate and Carlos Cantú differs from *C. capa* s. s. in the shorter, slightly broader, and less compressed outline; the slightly higher rib count; the more sharply defined, cordlike radials; the stronger concentric imbrication on the posterior ribs, at least on the left valve; and, on a few of the better-preserved specimens, evidence of rounded secondary threads on either side of the primaries, outlining them and demarking the shallow interradiial channels.

**DISTRIBUTION:** Laredo formation: middle Laredo, U.S.G.S. sta. 13634 (M-24); U.S.G.S. sta. 13642 (M-25); U.S.G.S. sta. 13644 (M-25); U.S.G.S. sta. 13645 (M-25).



*Chlamys capa jouda* Gardner n. subsp.

(Plate 1, figure 17)

Shell small, compressed, forming, with the exclusion of the auricles, a segment of roughly 90°; moderately heavy for the group. Radials 24 in the holotype, a right valve, but showing in collateral material an unusual amount of individual variation due in part to increase at the submargins; ribs continuous from the umbones to the outer margins, sharply defined, with flattened crests noded by the concentric growth imbrications which override them; interrarial channels broad and gently curved, of approximately the same width as the radials, evenly imbricated in well-preserved specimens. Submargins rather narrow, concentrically imbricated; obscure and fortuitous radials occasionally present. Anterior right auricle narrow and produced, the posterior right auricle and the anterior and posterior left auricles small and trigonal, each of them coarsely threaded with 3 to 5 lirae. Ctenolium coarse, distinct. Characters of the interior little known. Ligament pit short, wide, trigonal. Dorsal margins and crurae so worn that their original character is obscured. Muscle impressions not observed. Inner margin coarsely crenated in harmony with the ribbing.

DIMENSIONS OF HOLOTYPE (RIGHT VALVE): Height, 16.5 millimeters; width, 16.7 millimeters.

TYPE MATERIAL, HOLOTYPE, A RIGHT VALVE: U. S. Nat. Mus. 496024.

TYPE LOCALITY: U.S.G.S. sta. 13542 (J-13). Upper part of Laredo formation.

*Chlamys capa jouda* differs from *C. capa* s.s. of the Santa Ana fauna in the shorter, broader, commonly less compressed outline, the slightly more numerous, more highly decorated ribs, and the stronger concentric imbrication, both on the radials and in the broadly curved interrarial channels.

DISTRIBUTION: Laredo formation: upper Laredo, U.S.G.S. sta. 13542 (J-13); U.S.G.S. sta. 13545 (J-15).

*Chlamys* sp. cf. *C. nupera* (Conrad)

(Plate 1, figure 19)

Synonymy and description of *Chlamys nupera* (Conrad):

- 1854. *Pecten nuperum* Conrad. WAILES, Agriculture and Geology of Mississippi, Rept. (name only), p. 289, pl. 14, fig. 11.
- 1855. *Pecten nuperus* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., 1st ser., vol. 7, p. 259.
- 1865. *Pecten nuperus* CONRAD, Am. Jour. Conchology, vol. 1, p. 14.
- 1881. *Pecten nuperus* Conrad. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1881, p. 417.
- 1885. *Pecten nuperus* Conrad. MEYER, Am. Jour. Sci., 3d ser., vol. 29, pp. 459, 467.
- 1896. *Pecten nuperus* Conrad. VAUGHAN, U. S. Geol. Survey, Bull. 142, p. 50.
- 1898. *Pecten (Chlamys) nuperus* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 739.
- 1936. *Chlamys (Chlamys) nuperus* (Conrad). ROWLAND, Am. Mid. Nat., vol. 17, p. 1000, pl. 10, fig. 6.

"Suborbicular, ventricose, with about twenty-three angular, prominent ribs, crossed by fine, closely-arranged wrinkled lines; ears finely striated obliquely.

"A single valve with the ears broken is all of this species in the collection." Conrad, 1855.

Specimens, of middle or upper Jackson age from the Zacate area, have very sharp crests and a lower rib count than those from Mississippi. The material is not adequate to determine the range of individual variation and to establish the relationship of the Mexican valves with 18 ribs to those with 23 ribs from Jackson, Mississippi. The figured right valve (U. S. Nat. Mus. 494974) is from U.S.G.S. sta. 13467 (M-11).

*Chlamys* sp.

Several species are represented in the indeterminate fragments from the Oligocene series. Two fragments indicate a species with 25 or more ribs. Another may be referable to the group of *thetidis* Sowerby, widespread in the Antillean region. Although not recognizable specifically, they are certainly unlike any known from the Gulf Oligocene and more closely resemble forms from the highly diversified pectinid faunas of the Antilles. This shift in the relationships of the northeastern Mexican Oligocene faunas is evident in a number of the other groups of Mollusca.



Subgenus *Aequipecten* Fischer

1886. *Aequipecten* FISCHER, Manuel de conchyliologie, p. 944.

TYPE, BY MONOTYPY: *Ostrea opercularis* Linnaeus. Recent in European waters.

Shell rather thin, brittle, of moderate dimensions, the circumference between the dorsal margins an arc of not far from 270°. Left valve more inflated than the right and more deeply colored. Primary ribs strong and regular, the number not increased by intercalation; a secondary liration developed on both the radial and interradiar areas. Auricles fairly large, subequal. Byssal notch deep; ctenolium strong. Dorsal margin of right valve bent sharply downward to contact the erect margins of the left valve. Inner dorsal margins reinforced by a single pair of cardinal crurae. Marginal ligament grooves shallow, the chondrophore rather small and not very deep. Single muscle impression obscure, circular, included, for the most part, within the upper posterior quadrant. Inner margins crenate in harmony with the primary ribbing.

*Aequipecten* is set apart by the not very marked difference in the inflation of the valves, the gently sloping dorsal margins, and the absence of intercalated primaries.

*Chlamys* (*Aequipecten*) sp. cf. *C. (A.) plurinominis* (Pilsbry and Johnson)

Synonymy and description of *Chlamys* (*Aequipecten*) *plurinominis* (Pilsbry and Johnson):

1873. *Pecten oxygonum* Sowerby. GABB, Am. Philos. Soc., Trans., vol. 15, p. 256.  
Not *Pecten oxygonum* Sowerby, Quart. Jour. Geol. Soc. London, vol. 6, p. 52, 1849.
1898. *Pecten* (*Aequipecten*) *thetidis* Sowerby. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 714.  
Not *Pecten thetidis* SOWERBY, Quart. Jour. Geol. Soc. London, vol. 6, p. 52, 1849.
1917. *Pecten plurinominis* PILSBRY AND JOHNSON, Acad. Nat. Sci. Philadelphia, Proc., p. 193.
1921. *Pecten plurinominis* PILSBRY AND JOHNSON, Acad. Nat. Sci. Philadelphia, Proc., p. 411, pl. 45, figs. 1, 2.

"In this scallop there are 19 rounded ribs a little wider than their intervals, over ribs and intervals there are weak radial cords bearing thin scales, near the edge of the left valve there are three of these scaly cords upon each rib and three in each interval. Submargins and ears with numerous small ribs. Ctenolium is rather long. The right valve is slightly more convex than the left.

"Length and alt. 31 mm.

"Type No. 3236, A.N.S.P." Pilsbry and Johnson, 1917.

The species is included in the Gabb collection from Santo Domingo.

A single right valve from the Guajalote formation at U.S.G.S. sta. 13455 (W-29), 3950 meters N. 24½° W. of the church tower in San Fernando, Tamaulipas, closely resembles the Santo Domingan species, but the umbonal angle is smaller, the crests of the ribs sharper, and the submargins apparently devoid of sculpture. It is probably referable to the group of "*Pecten thetidis*" widespread in the mid-Americas.

Subgenus *Lyropecten* Conrad

1862. *Lyropecten* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1862, p. 291.

TYPE, BY SUBSEQUENT DESIGNATION (DALL, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 695, 1898): *Lyropecten estrellanus* Conrad. Miocene of the Pacific Coast.

"Inequivalve, radiately costate; hinge with a triangular pit as in *Pecten* and diverging prominent teeth on each side the ligament cavity." Conrad, 1862.

The valves are generally large and coarse, both of them convex, the left valve slightly more inflated than the right. The costals, unlike those of *Chlamys*, s.s., are relatively few in number but very heavy and not dichotomous.

*Lyropecten* is the dominant group in the middle Miocene, conspicuous both by reason of its abundance and the large size of the individuals. The beginnings in the lower Miocene are modest, possibly because the group had not reached the peak of its development, possibly because the presumably cooler climate was more favorable. The heavy *Pecten*s of the Miocene of south Europe, *Gigantopecten* Rovereto and its synonym, *Macrochlamys* Sacco, are referable to *Pecten* rather than *Chlamys* because of the absence of a byssus. They differ from *Pecten*, s.s., only in the relative convexity of the left valve.



*Chlamys (Lyropecten?)* sp. cf. *C. (L.?) nicholsi neotera* Gardner

(Plate 11, figures 7, 9)

Synonymy and description of *Chlamys (Lyropecten?) nicholsi neotera* Gardner:

1926. *Chlamys (Plagiectenium) nicholsi* GARDNER, U. S. Geol. Survey, Prof. Paper 142-A, p. 48, pl. 12, figs. 5, 6, 1926 (part).  
 1936. *Chlamys (Lyropecten?) nicholsi neotera* GARDNER, Fla. Dept. Conservation, Geol. Bull. 14, p. 16, pl. 2, figs. 2, 3.

Shell of moderate dimensions, relatively high, somewhat produced posteriorly, the left valve inflated, the right valve less strongly convex. Umbonal angle a little more than 90°. Anterior dorsal margins short, the posterior obliquely produced. Ventral arc including more than 180°. Radials 22 in number in the right valve, 21 in the left of another individual, narrow, high, and spreading scarcely at all at the ventral margin. Intercostals U-shaped with straight sides and about the same width as the costals. Secondary threading, 3 on each of the primaries, developed near the close of the adolescent stage. Submargins smooth in the juvenile stages, lirate in the adult, the inner lirae increasing in prominence in the adolescent stages and developing into primary ribs. Incrementals fine and sharp, much more crowded in some individuals than in others. Auricles rather small. Byssal notch relatively deeper in the young than in the adults; threading upon the byssal ear rather coarse and irregular, imbricated by the incrementals. Lirae on the posterior right auricle, and the anterior and posterior left auricles, less coarse and more numerous. Ctenolium distinct. Length of hinge line slightly less than half the width of the shell. Ligament area narrow, persisting almost to the distal extremities of the hinge. Ligament pit small, trigonal, subumbonal. Cardinal crurae ill-defined. Monomyarian, the single muscle adductor scar obscure. Inner surface and ventral margin fluted in harmony with the external ribbing.

DIMENSIONS OF COTYPES: Right valve, height 59.0 millimeters; width, 56.5 millimeters; thickness, 12.0 millimeters. Left valve of another individual, height, 59.0 millimeters; width, 55.3 millimeters; thickness, 13.8 millimeters.

DIMENSIONS OF FIGURED SPECIMENS: Right valve, height, 20.0 millimeters; width, 19.8 millimeters; thickness, 4.5 millimeters. Left valve of another individual, height, 17.5 millimeters; width, 17.0 millimeters; thickness, 3.8 millimeters.

COTYPES: A right and a left valve of two different individuals, U. S. Nat. Mus. 372893.

FIGURED SPECIMENS: U. S. Nat. Mus. 495929.

TYPE LOCALITY: U.S.G.S. sta. 10603, gully south of the road and east of the bridge over White's Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Fla. Shoal River formation.

LOCALITY OF FIGURED SPECIMENS: U.S.G.S. sta. 13588 (W-30), 620 meters N. 55° W. from the church tower in San Fernando, Tamaulipas. Guajalote formation.

The subspecies *neotera* differs from *Chlamys nicholsi* s.s. in the more numerous and more angular ribs. Small Pectens slightly heavier than the young *Chlamys nicholsi neotera* from White's Creek but otherwise similar are present in abundance in the collections from the vicinity of San Fernando.

DISTRIBUTION: Guajalote formation: U.S.G.S. sta. 13584 (V-29); U.S.G.S. sta. 13455 (W-29); U.S.G.S. sta. 13588 (W-30).

*Chlamys (Lyropecten)* sp.

Fragments of a *Lyropecten* apparently comparable in size to those of the Miocene of the Atlantic seaboard and Florida were collected in the Guajalote formation at U.S.G.S. sta. 13587 (W-30), 3250 meters south of the church tower in San Fernando, Tamaulipas.

The general dimensions and character of the ribbing suggest *Lyropecten sayanus* Dall from the Oak Grove of Florida. Nothing comparable in dimensions has been found below the Oak Grove sand.

Subgenus *Nodipecten* Dall

1898. *Nodipecten* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 695.

TYPE, BY ORIGINAL DESIGNATION: *Ostrea nodosa* Linnaeus. Pliocene of Florida; Pleistocene and Recent of the Gulf of Mexico and the Antilles.



"Shell like *Lyropecten*, but the ribs intermittently nodose, with more or less prominent hollow nodes or bullae; radial striation pronounced; ears unequal, the posterior smaller, the valves often more or less oblique; imbricate surface layer sometimes very marked." Dall, 1898.

*Chlamys (Nodipecten) dumblei* Gardner, n. sp.

(Plate 11, figures 4, 6)

*Pecten condylomatus* DALL? of the check lists of Dumble and others.

Not *Pecten (Nodipecten) condylomatus* Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 729, pl. 34, figs. 14, 15, 1898.

Shell of moderate dimensions for the group, rather strongly convex, the beaks central or slightly anterior; apparent convexity affected by the knuckling of the valves, a character that varies widely in degree and position. Radials strong, rounded, slightly wider than the interradians, which are squarish in the region of the umbones but broadly U-shaped toward the ventral margin; a secondary threading developed on the fluted disk, the number running 10 to 12 to a unit of radial and inter-radial; entire radially sculptured surface overridden with scaly growth laminae. Submargins smooth and high. Ears small, sharply defined, threaded with 6 to 8 subequal lirae overridden by incrementals. Byssal notch deep. Ctenolium coarse. Resilifer small, trigonal, subumbonal, marginal ligament grooves shallow. Crurae fairly strong but rude, one set subparallel to the margins of the resilifer, the other at a low angle to the dorsal margins. Muscle scar very large. Pallial line remote from the strongly fluted ventral margin.

**DIMENSIONS:** Height of right cotype, 45.0 millimeters; of left cotype, 51.0 millimeters. Width of right cotype, 50.0 millimeters; of left cotype, 59.0 millimeters. Convexity of both right and left cotypes including knuckling, 17.0 millimeters.

**TYPE MATERIAL:** Two cotypes, a right valve, U. S. Nat. Mus. 494994, and a left valve of another individual, U. S. Nat. Mus. 494995; and two paratypes, the larger, U. S. Nat. Mus. 494955, and the smaller, U. S. Nat. Mus. 494956.

**TYPE LOCALITY:** Cotype, right valve, from U.S.G.S. sta. 13455, left valve from U.S.G.S. sta. 13585; larger paratype from U.S.G.S. sta. 13455, smaller paratype from U.S.G.S. sta. 13587. Guajalote formation.

The average dimensions are higher than those of the types, and many valves are 60 millimeters high and 65 wide. Though the species was abundant, perfect shells are extremely rare. The hinge devices were not very strong apparently, and the valves were separated and rolled about; the edges of many of them were chipped, and most of them were embedded in a highly tenaceous matrix.

The *Nodipectens* from the Guajalote formation were included in the early check lists of the San Fernando and Tuxpan faunas under *Pecten condylomatus*, described from the Chipola formation. Both species vary in size, degree of knuckling, and number of ribs, and the end members approach one another closely. The Mexican forms average larger, are less irregular in outline, and have a higher average rib count. They are similar to *Nodipectens* from the later Alum Bluff, particularly those from White's Creek which is probably early Shoal River in age.

Imperfectly preserved specimens from the lower Miocene of Trinidad, U.S.G.S. sta. 8299, may be identical with *Nodipecten dumblei*.

**DISTRIBUTION:** Guajalote formation: U.S.G.S. sta. 13584 (V-29); U.S.G.S. sta. 13585 (V-29); U.S.G.S. sta. 13587 (W-30); U.S.G.S. sta. 13588 (W-30).

Genus *Amusium* (Bolten) Roeding

1798. *Amusium* (Bolten) ROEDING, Museum Boltenianum, pt. 2, p. 165.

**TYPE, BY SUBSEQUENT DESIGNATION** (HERRMANNSEN, Indicis generum malacozoorum primordia, vol. 1, p. 47, 1846): *Ostrea pleuronectes* Linnaeus. Recent in the Indo-Pacific.

The valves are commonly large, thin, and feebly convex; like those of the true *Pecten* they are not attached by a byssus. Radial sculpture may be suggested by the color pattern but is rarely developed and is never strong. Some species are concentrically imbricated, particularly toward the ventral margin. The discrepancy in ornamentation so common in *Pseudamussium* is repeated in the coloring in *Amusium*, s.s. In *Amusium papyraceum*, the Recent Antillean shell, the right valve is white or bordered with pale yellow, but the left is a deep reddish or purplish brown. This general



type of color holds throughout *Amusium*, s.s. The lirae developed upon the inner surface of the disk are perhaps the most constant diagnostic of the genus.

Like *Pecten*, *Amusium* may be traced back to the Mesozoic. The thin, internally lirate shells require a more specialized habitat than the heavy, externally ribbed shells of most of the *Pecten* group, and perhaps for this reason the genus is relatively rare.

#### Subgenus *Parvamussium* Sacco

1897. *Parvamussium* SACCO, I molluschi dei terreni Terziarii del Piemonte e della Liguria, pt. 24, p. 48.

*Propeamusium* DALL, 1898, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 698 (part).

Not *Propeamusium* De Gregorio, 1884, Naturalista Sciliano, anno 3, p. 119.

Type by monotypy, *Pecten* (*Propeamusium*) *ceciliae* De Gregorio (Miocene of Sicily).

TYPE BY ORIGINAL DESIGNATION: *Pecten duodecim-lamellatus* Bronn. Miocene and Pliocene of Italy.

The subgenus is characterized by the small, delicate valves, the small, subequal auricles, the fine concentric imbrication, and the distant internal radials which do not persist to the ventral margin.

The representatives of this small group are not abundant, but they are widely distributed both in time and space.

#### *Amusium* (*Parvamussium*)? sp.

A pectenid about 3 millimeters in height and width, probably a left valve, was collected in the upper Mount Selman at U.S.G.S. sta. 13626 (L-24). The auricles are relatively large, and the submargins not sharply angulated. The most striking feature of the shell is the exceedingly fine, sharp, reticulate sculpture similar to that of the left valve of *Pseudamusium alabamense* (Aldrich). The interior is not accessible, and it is uncertain whether the delicately netted shell should be referred to *Pseudamusium* or to a subgenus of *Amusium* such as *Parvamussium*.

#### Family SPONDYLIDAE

#### Genus *Plicatula* Lamarck

1801. *Plicatula* LAMARCK, Système animaux sans vertèbres, p. 132.

TYPE, BY SUBSEQUENT DESIGNATION (SCHMIDT, C. F., Versuch über die beste Einricht., etc., pp. 61, 177, Gotha, 1818): *Spondylus plicatus* Linnaeus. Recent in the Orient.

Shell small, inequivalve, flattened or slightly convex, trigonal-ovate to subcircular, often irregular, attached, as a rule, in the adult by the umbone of the right valve, which is the larger. Outer surface generally plicate, the folds commonly bifurcating. Ligament internal, lodged in a subumbonal cartilage pit between the two heavy, divergent, transversely striated cardinal crurae. A single muscle impression in the adult, excentric and posterior. Pallial line entire. Margin fluted in harmony with the outer ribbing.

*Plicatula* differs from *Spondylus* in its small size, less ornate sculpture, and the absence of auricles.

The genus is recorded in the early Mesozoic, culminated in the late Mesozoic, and is represented by less than a dozen Recent species, most of them oriental.

#### *Plicatula lalajensis* Gardner, n. sp.

(Plate 5, figure 4)

Shell rather small, a strongly fluted disk with the area of attachment symmetrically placed. Plications strong, broad, and broadly rounded, radiating from the area of attachment and numbering about 16 in all; a fine, even, secondary radial threading developed upon both the costals and intercostals; the free edges of the concentric laminae rippling the shell along the crests of the costals. Interradials broadly U-shaped. Hinge inaccessible.

DIMENSIONS OF HOLOTYPE: Height, 15 millimeters; width, 15 millimeters.

TYPE MATERIAL: Holotype, a right valve, U. S. Nat. Mus. 495046.

LOCALITY OF HOLOTYPE: U.S.G.S. sta. 13484 (E-12), La Laja, Los Herreras, Nuevo León. Lower part of Indio formation of Wilcox group.



*Plicatula lalajensis* is similar in general aspect and sculpture pattern to *Plicatula filamentosa* Conrad described from Claiborne, Alabama. The curvature of the lateral and ventral margins of the Mexican species is more regular, and the ribs more numerous than in the species from the Claiborne fauna. Harris figured a "*Plicatula filamentosa* Conrad var." from the upper part of the Wilcox section in Alabama which differs from the Claiborne shell in the more numerous ribs. Those in our collections from the upper Wilcox of Alabama are probably identical with the form figured by Harris, but they seem closer to the Claiborne, Alabama, species than to that from Mexico. Intermediate forms in this notoriously variable group may later be found.

*Plicatula lalajensis* is known only from the type locality and from a locality which I have been unable to place on the map, "the west flank of the hill, Triangulation Point Loma," Nuevo León.

*Plicatula euplecta* Gardner, n. sp.

(Plate 1, figure 13, 14)

Shell small for the genus, the right attached valve feebly convex, the left valve a little smaller and irregularly warped. Dorsal margin short and straight, the ventral and lateral margins surrounding the relatively large attached area like a wide well-pleated circular apron. Radials 14 in the left valve, the vestiges of a fifteenth in the right, subacutely  $\Lambda$ -shaped; inter-radials also subangular, confined, in the left valve of the type, to the outer third of the disk. In the type, a single heavy resting stage indicated by incrementals which override the radials. Valves locked, and characters of interior not known. Ventral margin sharply serrate.

DIMENSIONS OF HOLOTYPE: Height, 11.6 millimeters; width, 11.6 millimeters; thickness, 5 millimeters.

HOLOTYPE (the locked valves of a single individual): U. S. Nat. Mus. 495930.

TYPE LOCALITY: U.S.G.S. sta. 13569 (H-12); middle part of Laredo formation of Claiborne group.

An individual, also with locked valves, from U.S.G.S. sta. 13567, exhibits fewer plications, owing probably to the mode of attachment, but the folds are strong and sharp.

*Plicatula euplecta* is the Mexican affiliate of the *filamentosa* Conrad group of the Claiborne of the eastern and western Gulf. It is relatively small for that group, the area of attachment is relatively large, the outline broad, the plications numerous, sharp, and regular. The holotype is attached to a well-preserved fragment of *Trochopora bouei* (Lea).

OCCURRENCE: Laredo formation: middle Laredo, U.S.G.S. sta. 13567 (H-11); U.S.G.S. sta. 13569 (H-12); ?U.S.G.S. sta. 13547 (I-14).

Superfamily ANOMIACEA

Family ANOMIIDAE

Genus *Anomia* (Linnaeus) Müller

1758. *Anomia* LINNAEUS, Systema naturae, 10th ed., p. 700 (part).

1776. *Anomia* MÜLLER, Zoologiae danicae, prodromus seu animalium, p. 248.

Type, by subsequent designation (Schmidt, Versuch., über die beste Einricht., etc., pp. 71, 177, 195, Gotha, 1818): *Anomia ephippium* Linnaeus. Recent off the European shores from the Arctic Ocean to the Aegean archipelago; fossil in the Pliocene of England and Italy and the Pleistocene of Scandinavia.

Shell inequivalve, adherent, generally subcircular or oblong. Left valve more or less convex; right valve flattened. Hinge margin of left valve commonly incurved and slightly thickened. Ligament scar directly beneath left umbone. Interior of disk of left valve scarred with an adductor and a major and a minor byssal impression, the major byssal scar the largest of the three and dorsal to the adductor and minor byssal scars, which are usually subequal. Interior of right valve containing foraminal opening and, ventral to it, the impression of the adductor muscle; posterior dorsal margin of right valve carrying an inconspicuous ligamental process. Pallial line simple.

Ancestral forms of this genus have been recognized in rocks as ancient as the Devonian. The recent species number about 40 and are widely distributed along the shores from low-water mark to 100 fathoms.



*Anomia malinchae* Gardner, n. sp.

(Plate 5, figures 1, 2)

Shell large, subcircular or somewhat oblique; inflation rather marked in the umbonal area, uniform over the disk. Umbones small and pointed, turned inward. Dorsal margins commonly in the same horizontal plane. Outer surface corrugated with a *Clementia*-like sculpture of low ripples that become less prominent toward the ventral margin. Characters of the interior and of the right valve not known.

DIMENSIONS OF HOLOTYPE: Height, 55 millimeters; width, 51 millimeters.

TYPE MATERIAL: Holotype, a left valve; U. S. Nat. Mus. 494959; paratype, a left valve, showing Outline of dorsal margins, U. S. Nat. Mus. 494960.

TYPE LOCALITY: Holotype, U.S.G.S. sta. 13458 (B-10); paratype, U.S.G.S. sta. 13605 (B-10).

A species so imperfectly preserved would not be recognized taxonomically except for its abundance in a restricted range and the improbability of finding more complete examples later. It was reef-forming in the shallow seas that marked the close of the Midway and the opening of the Wilcox in northern Mexico. *A. malinchae* is the largest species described from the Gulf Eocene, and the most nearly circular in outline. The outer surface is apparently smooth excepting for the concentric rippling.

DISTRIBUTION: Indio formation: lower Indio, U.S.G.S. sta. 13609 (B-5); U.S.G.S. sta. 13474 (B-6); U.S.G.S. sta. 13458 (B-10); U.S.G.S. sta. 13605 (B-10).

*Anomia malinchae* Gardner?

Masses of an old reef in large part composed of a thin-shelled, subcircular form, 50 to 70 millimeters in diameter, probably *A. malinchae* Gardner, occur at several localities near the base of the Wilcox. The beaks are small and pointed at the tips, rising only slightly above the dorsal margins, which are commonly in a single horizontal line. There is a certain amount of warping and rippling in many of the shells, but no definite sculpture pattern though it is doubtful if the surface is preserved in any single specimen. The color is very dark, indicating possibly an admixture of carbon with the calcite. Such a reef was well developed at U.S.G.S. sta. 13458 (B-10). The same species is abundant at U.S.G.S. sta. 13605 (B-10), lower Indio, and is present at U.S.G.S. sta. 13609 (B-5), about 100 meters southwest of the Agualeguas-General Treviño Road, 1.5 kilometers from Agualeguas, Nuevo León.

*Anomia* sp.

Fragments of a species about 10 millimeters in diameter from the upper Midway at U.S.G.S. sta. 13486 (E-18) retain traces of a fine pustulose radial sculpture. *Anomia ephippioides* Gabb abundant in the lower Claiborne of the embayment exhibits a similar type of ornamentation.

*Anomia* sp. cf. *A. lisbonensis* Aldrich

Synonymy and description of *Anomia lisbonensis* Aldrich:

1886. *Anomia ephippioides* Gabb var. *Lisbonensis* ALDRICH, Geol. Survey Alabama, Bull. 1, p. 41, pl. 4, fig. 6.  
 1898. *Anomia lisbonensis* Aldrich. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 781.  
 1919. *Anomia lisbonensis* Aldrich. HARRIS, Bull. Am. Paleontology, vol. 6, p. 17, pl. 11, figs. 6-10.  
 1931. *Anomia lisbonensis* Aldrich. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 104.

"Shell thin, pearly, suborbicular; upper valve smooth, slightly wrinkled on the umbo; lines of growth distant, hinge line doubly sigmoid, the extremities winged. Muscular scars indistinct.

"*Locality*.—Lisbon and beds at base of Claiborne Bluff.

"The type is externally marked with broad radiating bands of color. On comparison with *A. ephippioides*, Gabb, it appears much larger and more transverse; that species is not smooth externally, and is often plicate. It occupies the same horizon however." Aldrich, 1886.

The typical *lisbonensis* characterized by the relatively large thin greenish shell with full umbones and without macroscopic sculpture has not been recognized in the Rio Grande Embayment. Two small left valves between 10 and 20 millimeters in height and width from the lower Laredo formation



of northeastern Mexico (U.S.G.S. sta. 13564, H-12 and U.S.G.S. sta. 13969, I-19) suggest *Anomia lisbonensis* but by no means establish the species.

Lower in the stratigraphic section and associated with *Ostrea lisbonensis* at U.S.G.S. sta. 13622 (L-23) is an abundant *Anomia* smaller than *A. lisbonensis* but smooth or feebly hachured. This may be *Anomia sellardsi* of Renick and Stenzel (Univ. Texas Bull. 3101, p. 108, pl. 6, figs. 3, 4, 1931), but the figure of *sellardsi* is not very clear, there is no descriptive text, and the material has not been examined. The general outline and dimensions are the same in both forms, and they are both restricted to the upper Mount Selman.

*Anomia* sp. cf. *A. hammetti* Harris

Synonymy and description of *Anomia hammetti* Harris:

1919. *Anomia navicelloides* var. *hammetti* HARRIS, Bull. Am. Paleontology, vol. 6, p. 18, pl. 12, figs. 1, 2.

"Shell long-ovoid as illustrated; rather thick, very flat, somewhat curved; exterior marked by a large number of irregularly divaricating radiate riblets having a tendency to develop minute, hollow prickles; broad, concentric undulations irregularly disposed.

"Along with this upper left valve there are fragments of heavy right valves, shown on pl. 11, figures 4 and 5 that in all probability belong to this species, though we have not thus far found two valves together to prove the question beyond a doubt. These show a remarkable thickening about the opening as well as about the whole cardinal area.

"Type.—Deposited in Pal. Mus., C.U.

"Horizon.—St. Maurice Eocene.

"Specimens figured.—From Hammett's Branch, La.

"Localities.—Hammett's Branch and Bayou Negreet, La." Harris, 1919.

*Anomia navicelloides* Aldrich (Nautilus, vol. 11, p. 97, 1898; Nautilus, vol. 16, p. 99, pl. 4, figs. 13, 14, 1903) was described from Choctaw Corner, Alabama, and is of Woods Bluff (Bashi) age. The types of *navicelloides* and *hammetti* have not been examined, but the figures indicate differences sufficiently important to separate them specifically even though the time differences are not considered.

Some perplexing forms from the Laredo formation of northeastern Mexico may be referable to *Anomia hammetti*. They are characterized by a remarkably heavy shell, an unusually regular ovate outline, a short straight hinge reminiscent of *Lima*, and a surface sculpture of fine, sharp, crowded, more or less pustulose radials.

They differ from *Anomia ephippioides* Gabb in the much heavier shell, the greater regularity of outline, and the initiation of continuous radials in the early growth stages. In *Anomia ephippioides*, the radials, if developed at all, are preceded by a pustular sculpture in which there is no evident orientation.

DISTRIBUTION: Laredo formation: middle Laredo, U.S.G.S. sta. 13984 (H-6); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13554 (I-14); U.S.G.S. sta. 13547 (I-14).

*Anomia ephippioides* Gabb

(Plate 1, figures 16, 18)

- 1860. *Anomia ephippioides* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 388, pl. 67 fig. 59.
- 1865. *Anomia ephippioides* Gabb. CONRAD, Am. Jour. Conchology, vol. 1, p. 15.
- 1881. *Anomia aphippioides* Gabb. MILLER, Cincinnati Soc. Nat. History, Jour., vol. 4, No. 1, p. 9.  
(Error for *ephippioides*.)
- 1887. *Anomia ephippioides* Gabb. ALDRICH, Cincinnati Soc. Nat. History, Jour., vol. 10, p. 81.
- 1891. *Anomia ephippioides* Gabb. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, p. 404.
- 1895. *Anomia ephippoides* Gabb. VAUGHAN, Am. Geol., vol. 15, pp. 213, 216, 218.
- 1898. *Anomia ephippioides* Gabb. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 782.
- 1919. *Anomia ephippioides* Gabb. HARRIS, Bull. Am. Paleontology, vol. 6, p. 16, pl. 11, figs. 1-3.
- 1931. *Anomia ephippioides* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 104.

"Very irregularly subquadrate, sometimes nearly circular, sometimes almost triangular; convex, occasionally marked by longitudinal rugae, and always by distinct lines of growth; lower valve, the muscular foramen large; ligament margin thickened.

"Size of largest specimen.—Length 1.5 in., width 1.3 in.

"Common." Gabb, 1860.



HOLOTYPE: Acad. Nat. Sci. Philadelphia 2719.

TYPE LOCALITY: Wheelock, Texas.

DIMENSIONS OF FIGURED SPECIMEN: Height, 21 millimeters; width, 22.5 millimeters; convexity (shell warped), 2.6 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 495021.

LOCALITY OF FIGURED SPECIMEN: U.S.G.S. Sta. 13595, 10.5 kilometers east of China, Carlos Cantú, Nuevo León. Lower part of Laredo formation of the Claiborne group.

Dall indicated (1898, p. 782) that in the original description

"The chief specific character is not alluded to. The young when in perfect condition are covered with minute pustules; as the shell approaches maturity these elongate and become close-set, rather coarse threads, separated by narrower grooves. In perfect condition it can not be mistaken for any other American species. This sculpture, it should be clearly understood, is normal to the species and entirely independent of irregularities due to *situs*."

Typical *Anomia ephippioides* is rare in the Rio Grande Embayment. On the Texas side, particularly in southern La Salle and in Webb counties, the species commonly referred to *ephippioides* is relatively large, of much the same size and outline as the *lisbonensis* of Anderson County, and is more strongly and more regularly sculptured than the *ephippioides* of Robertson and Brazos counties. The area of the pustular surface is much reduced relatively, and the sculpture approaches that of *A. hammetti* Harris, but the shell is not so heavy, so flat, nor so regular in outline as it is in the Harris species. The Mexican material is rather meager and not well preserved. The shells do not reach the dimensions of those in Arroyo Chacon near Laredo, but the sculpture is as a rule less blistered and more regular in its orientation than that on specimens of the Brazos River area. The figured specimen is, however, true *ephippioides*. Probably *Anomia hammetti* is a near relative and the two species approach one another closely in their peripheral members.

DISTRIBUTION: Laredo formation: lower Laredo, U.S.G.S. sta. 13595 (H-15); ?U.S.G.S. sta. 13968 (I-19).

DISTRIBUTION OF FORMS WITH A FAIRLY STRONG AND CONTINUOUS RADIAL SCULPTURE: Laredo formation: lower Laredo, U.S.G.S. sta. 13564 (H-12); middle Laredo, U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13594 (H-13); U.S.G.S. sta. 13593 (I-13); U.S.G.S. sta. 13547 (I-14); U.S.G.S. sta. 13553 (H-15); upper Laredo, U.S.G.S. sta. 13768 (G-3); U.S.G.S. sta. 13771 (H-3).

#### *Anomia* sp. cf. *A. floridana* Dall

Synonymy and description of *Anomia floridana* Dall:

1898. *Anomia floridana* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 783, pl. 35, fig. 7.

1926. *Anomia floridana* Dall. GARDNER, U. S. Geol. Survey, Prof. Paper 142, p. 54, pl. 13, fig. 10.

"Shell of moderate size, usually rather convex, the surface irregular, obsoletely microscopically radially striated, more or less irregularly feebly pustular and with obsolete, broken feeble radial plications; the minor byssal scar is above and slightly further back (about half its own width) than the adductor scar of the same size; the major byssal scar is rounded and much larger, situated directly above the minor one, so that the three scars are nearly in one dorsoventral line; the beak of the left valve is at the cardinal margin. Altitude of largest specimen, 35 millimeters, latitude 39 millimeters.

"This species is intermediate in size and character between *A. microgrammata* Dall and *A. ruffini* Conrad. It is smaller and less sculptured than the latter, which also wants the microscopic striation; it is larger, less sharply striated, and has the beak and scars situated differently from the former. Many of the specimens still retain some of the original greenish coloration." Dall, 1898.

TYPE: U. S. Nat. Mus. 135845.

TYPE LOCALITY: U.S.G.S. sta. 2646, Oak Grove, Yellow River, Okaloosa County, Fla.

The sculpture of *A. floridana* seems to be of much the same fortuitous character as that of *A. simplex* D'Orbigny. No difference can be detected between the Oak Grove and Shoal River species. The greenish color is characteristic of this species and unlike anything observed in its associates.

A few immature individuals exhibiting the curious dense texture of *Anomia floridana* were collected from the Guajalote formation. The type locality of *A. floridana* is at Oak Grove, but the



species is common in the Shoal River and at White's Creek. It has not been recorded from the Chipola formation.

DISTRIBUTION: Guajalote formation: U.S.G.S. sta. 13588 (W-30).

Superfamily OSTREACEA

Family OSTREIDAE

Genus *Ostrea* (Linnaeus) Lamarck

1758. *Ostrea* LINNAEUS, Systema naturae, 10th ed., p. 696.

1799. *Ostrea* LAMARCK, Prodrome d'une nouvelle classification des coquilles: Soc. hist. nat. Paris, Mém., p. 81.

TYPE, BY SUBSEQUENT DESIGNATION (SCHMIDT, C. F., Versuch über die beste Einricht., etc., pp. 69, 177, Gotha, 1818): *Ostrea edulis* Linnaeus. Recent off the European shores from Iceland to the Adriatic.

*Ostrea*, the common oyster, is doubtless by reason of its great economic value the most widely known of the molluscan genera. The shell is inequivalve, generally irregular and more or less inequilateral. Except in the larval stages it is attached by the convex left valve. The right valve, which is flattened or slightly concave, serves as a cover. The hinge is edentulous. There is a single muscle scar, the posterior, and this is subcentral. The pallial line is simple but not well defined.

The genus has been prominent in all the molluscan faunas from the Mesozoic onward. Two hundred and forty species have been recognized in the Cretaceous alone, and, throughout the Tertiary, *Ostrea* forms one of the most conspicuous elements of nearly every fauna.

As in all attached forms, the variation is great, but many of the Eocene oysters are remarkably well characterized, widely dispersed, and of limited stratigraphic range and consequently of great service in correlation.

*Ostrea eothirsae* Gardner, n. sp.

(Plate 5, figures 10, 11)

Shell small, the attached valve approximating the size and shape of an olive sectioned through the median vertical; the right cover valve flat. Curvature of left valve both transverse and horizontal, fairly uniform, the beaks at the extremity of an obscure umbonal ridge and acute only at their subcentral tips which are turned inward and slightly forward. Umbone on right valve merely a slightly bulbous medial expansion of the dorsal margin. Outer surface probably decorticated in all available material. No evidence of radial fluting or of lateral flanges on the left valve. Right valve crudely wrinkled concentrically. Characters of interior imperfectly known. Subumbonal ligament area very small. Dorsal margins of right valve feebly denticulated. Muscle scars obscure.

DIMENSIONS OF HOLOTYPE: Left valve, length, 16 millimeters; width, 9.5 millimeters.

HOLOTYPE: U. S. Nat. Mus. 559392.

TYPE LOCALITY: U.S.G.S. sta. 13464, 7 kilometers east of the old church in Cerralvo, Nicolas Garcia Hacienda, Nuevo León. Lower part of Midway formation.

*Ostrea eothirsae* is apparently a primitive representative of the *Ostrea thirsae* group, so abundant and widespread during the lower Wilcox. It is smaller than the Nanafalia type, and the curvature of the profile is lower and more uniform with no pronounced umbonal ridge and no lateral flanges. The gradation from these small, simple linguloid shells to the large, highly convex and alate forms is, in the lower Eocene of northeastern Mexico, almost unbroken. Within certain limits, the size and outline of the representatives of the *thirsae* stock are among the best faunal age indicators.

DISTRIBUTION: Midway formation: lower Midway, U.S.G.S. sta. 13459 (B-6); U.S.G.S. sta. 13473 (B-6); U.S.G.S. sta. 13472 (B-6); U.S.G.S. sta. 13460 (B-7); U.S.G.S. sta. 13471 (B-9); U.S.G.S. sta. 13470 (B-9); U.S.G.S. sta. 13464 (B-9); U.S.G.S. sta. 13463 (B-9); Midway of undetermined age, ?U.S.G.S. sta. 13653 (C-17); U.S.G.S. sta. 13489 (D-18); upper Midway, ?U.S.G.S. sta. 13488 (D-18); ?U.S.G.S. sta. 13486 (E-18); ?U.S.G.S. sta. 13765 (E-18), ?U.S.G.S. sta. 13758 (B-19).



*Ostrea thirsae* (Gabb)

(Plate 5, figures 15-19)

1861. *Gryphaea thirsae* GABB, Acad. Nat. Sci. Philadelphia, Proc. for 1861; p. 329.  
 1884. *Ostrea thirsae* Gabb. HEILPRIN, in WHITE, U. S. Geol. Survey, 4th Ann. Rept., App. 1, p. 311, pl. 63, figs. 4-6.  
 1886. *Gryphaea thirsae* Gabb. ALDRICH, Geol. Survey Alabama, Bull. 1, p. 58.  
 1897. *Ostrea thirsae* Gabb. HARRIS, Bull. Am. Paleontology, vol. 2, no. 9, p. 40, pl. 6, figs. 5, 6.  
 1900. *Ostrea thirsae* Gabb. HARRIS, State Experiment Station, Geol. Agric. Louisiana, pt. 5, Spec. Rept. No. 6, p. 300, pl. 53, fig. 1.  
 1906. *Ostrea thirsae* Gabb. VEATCH, U. S. Geol. Survey, Prof. Paper 46, p. 35, pl. 18, figs. 2, 2a, 2b.  
 1925. *Ostrea thirsae* Gabb. COOKE, U. S. Geol. Survey, Prof. Paper 140-E, p. 134.  
 1926. *Ostrea thirsae* Gabb. COOKE, Geol. Survey Alabama, Spec. Rept. 14, pp. 258-262, pl. 94, figs. 6a, 6b.

The holotype is a left valve, U. S. Nat. Mus. 494957 (570 of the old series) from Nanafalia, Marengo County, Alabama.

A right valve (U. S. Nat. Mus. 494964) from the same collection has been figured.

"Rounded-subtriangular. Lower valve; beak very small, and close to the hinge, never exsert. Umbone rounded, very prominent and somewhat compressed laterally, the rounded elevation continuing more or less regularly, becoming broader, to the middle of the basal margin, at which point this margin is always somewhat emarginate. Ligament area broad, triangular, transversely striate, and with a slight, irregular depression in the middle. Interior of valve very deep. Muscular impression nearly ovoid, narrowest on the inner end. External surface marked by a few small, irregular squamose ridges, most numerous and distinct directly behind the emargination of the base. Upper valve unknown.

"The specimens are in the Museum of the Smithsonian Institute (No. 570) and are from a light gray sandy marl.

"Locality, 'Nanafalia,' Alabama.

"Length, 1.7 in. Greatest width, 1.3 in. Width at the hinge, .6 in. Greatest height of valve, .8 in. Height at the hinge, .7 in. Length from the basal margin, over the umbone, to the beak, 2.3 in.

"The measurements above were all taken from one specimen; they vary a little but the shape and proportions are very nearly alike in all the specimens I have seen." Gabb, 1861.

Shell laterally compressed with a high, sharply rounded ridge extending from the umbones to the ventral margin. Posterior slope beveled, very much more abrupt than the anterior. Umbones orthogyrate. Hinge area relatively broad, trigonal, subequilateral, the medial depression not very pronounced. Adductor scar very feeble.

Height of holotype, 42.4 millimeters; width, 27.6 millimeters; diameter, 21.5 millimeters.

Specimens from the type collection show a sinus behind the umbonal ridge that is in some individuals pronounced. The variation in size is great, one possibly abnormal specimen reaching 55 millimeters both in height and in width. Most of the shells are heavy, and the growth lines are conspicuous toward the ventral margin. The young left valves are less convex than the adults and have a longer and gentler anterior slope. The right valve frequently shows a vertical warping, a bowing of the shell between the hinge and the ventral margin. There is usually, too, some hint of depression along the ventral margin corresponding to the umbonal ridge of the left valve. The umbonal thickening in the right valve is marked, and the growth lines in some individuals suggest those of *O. vomer*. One specimen shows radial threadlets on the dorsal third suggesting those of *O. sellaeformis*, of which it is the possible ancestor. The hinge area is broad and low. The vermicular markings along the lateral margins are rather conspicuous. The inconspicuous orthogyrate beaks readily separate the lower Wilcox *Ostrea thirsae* from the lower Midway *Ostrea pulaskensis* Harris.

The occurrence of *Ostrea thirsae* in the eastern Gulf and in Louisiana is practically synchronous with outcrops of the Nanafalia formation. Although the species is reef-making only in the Nanafalia, it has a meager distribution in the succeeding Tuscaloosa formation. In Texas, it has been recognized only in Maverick County, and the determination of even those representatives is a little dubious.

In Mexico, it is known only from the San Juan section and from a small area east of Cerralvo which is not included in our numbered collections.

The black calcite oyster breccias of the San Juan section, commonly with associated hunters-green glauconite, may be derivatives of *Ostrea thirsae* reefs. Such breccias are represented in col-



lections from U.S.G.S. sta. 13655 (D-17), Loma Chapeño; and U.S.G.S. sta. 13652 (D-18), Rio San Juan, opposite Rancho Viejo, China, Nuevo León.

**DISTRIBUTION:** Midway formation: undivided Midway, ?U.S.G.S. sta. 13653 (C-17); U.S.G.S. sta. 13490 (D-18), shells abundant and typical; U.S.G.S. sta. 13491 (D-18), shells rather small; U.S.G.S. sta. 13492 (D-18), shells rather small and very abundant, umbonal keel subacute; upper Midway, ?U.S.G.S. sta. 13488 (D-18), shells small and thinner than the typical *O. thirsae*, possibly *O. eothirsae*; upper Midway or lower Wilcox, U.S.G.S. sta. 13487 (D-18), shells large with a prominent subacute umbonal ridge; U.S.G.S. sta. 13550 (D-18); U.S.G.S. sta. 13650 (D-18); U.S.G.S. sta. 13450 (D-19), abundant left valves with high rostrate beaks and high cardinal areas. Wilcox group. Indio formation: lower Indio, U.S.G.S. sta. 13761 (D-18), left valves only, large and heavy with a narrow and prominent umbonal ridge; U.S.G.S. sta. 13652 (D-18), large fine *O. thirsae* with high, narrow umbones, two of them measuring about 55 millimeters in height and one of the two with a very pronounced alar flange; U.S.G.S. sta. 13764 (not indicated in map), float of small oysters; shells heavy, most of them rather small, the left valves strongly beveled from the high, narrow umbonal ridge, the posterior slope much steeper than the anterior; right valves flattened and sculptured only with concentric growth lines toward the ventral margin; U.S.G.S. sta. 13760 (D-19), shells rather small, heavy, with pinched umbones and a high and narrow umbonal ridge; umbones higher and narrower than at Nanafalia, otherwise similar; no right valves included in a rather long series; U.S.G.S. sta. 13649 (E-18), a single large left valve with a well-developed alar flange.

*Ostrea* sp. cf. *O. intermedoides* Aldrich

Synonymy and description of *Ostrea intermedoides* Aldrich:

1921. *Ostrea intermedoides* ALDRICH, Bull. Am. Paleontology, vol. 9, no. 37, p. 23, pl. 3, figs. 15, 16.

"Shell medium, valves rather thin; surface in older specimen with numerous raised concentric ribs; the lower valve bent downwards near the beak; the umbo shows radial striae; margins crenulated internally; a fragment of the upper valve appears to be flat. Length of lower valve 32 mm; breadth about 20 mm.

"*Locality*.—Bell's Landing marl, Bell's Landing, Ala. River, Ala.

"*Type*.—Ala. Museum of Nat. History.

"*Remarks*.—Have hesitated to add another oyster to our Eocene but I have been unable to find a place for this species. Four lower valves and a fragment of the upper valve are in the collection. The ornamentation recalls *O. falco* Dall from the Jacksonian." Aldrich, 1921.

Directly below the Carrizo sand in northeastern Mexico is the remnant of an old oyster reef. In most localities from which collections have been made, the shells are so brecciated that specific determinations are impossible. At a few localities the shells are apparently *in situ*, and certain characters can be determined. The attached left valve is usually boat-shaped with a high convexity along the dorsoventral axis. The umbones are narrow, the ligament area high and narrow and usually inclined slightly backward. Some of the shells show a few fairly strong ripples which do not, however, extend more than half way up to the umbones. The cover valve is the more characteristic, possibly because it is less directly affected by its environment. It is regularly ovate in outline, narrowing slightly toward the umbones. The entire surface is evenly laminated concentrically and radially shagreened, the radials too fine to catch under ordinary high magnification and related to the structure of the shell rather than to a superimposed ornamentation. The ligament area is flattened and broad, the vermicular markings along the lateral margins fairly strong. The single adductor is crescentic, slightly posterior and strongly ventral in position. The right valves average about 25 to 30 millimeters in height and 15 to 20 in width. Specimens were submitted to the Paleontological Laboratory at the University of Alabama where the Aldrich types are deposited. The Aldrich material is not extensive, and Miss McGlamery, who kindly compared them for me, did not consider the identity of the Alabama and the Mexican forms established, nor certainly distinct. In any case, their resemblance is sufficiently close to be interesting and, I believe, significant. In Mexico, *Ostrea* sp. cf. *O. intermedoides* occurs, for the most part, as a more or less brecciated reef and more rarely in association with the *Venericardia diga* and the *Galeodea koureos* faunas, both presumably of Tusahoma age. The Alabama species, *O. intermedoides*, was described from the Bells Landing marl, the upper member of the Tusahoma formation. There is no allied species known from the later Wilcox and, in northeastern Mexico, no certain record of faunas of upper Wilcox age.



DISTRIBUTION: Indio formation: upper Indio, U.S.G.S. sta. 13725 (E-3); U.S.G.S. sta. 13724 (E-3); U.S.G.S. sta. 13723 (E-3); U.S.G.S. sta. 13713 (E-4); U.S.G.S. sta. 13742 (E-4); U.S.G.S. sta. 13719 (E-4); U.S.G.S. sta. 13720 (E-4); U.S.G.S. sta. 13475 (E-5); U.S.G.S. sta. 13691 (F-5); U.S.G.S. sta. 13672 (E-10).

DISTRIBUTION OF BRECCIA PROBABLY DERIVED FROM *Ostrea* sp. cf. *O. intermedoides* ALDRICH—Indio formation: upper Indio, U.S.G.S. sta. 13727 (D-2); U.S.G.S. sta. 13716 (E-4); U.S.G.S. sta. 13717 (E-4); U.S.G.S. sta. 13718 (E-4).

*Ostrea semmesi* Gardner, n. sp.

(Plate 2, figures 6, 8)

Shell small, thin, warped, elongate-ovate, attached over most of the surface of the left valve. Umbones narrow, not very high nor conspicuously thickened, directed backward. Ligament area in left valve high, pinched into a subacute angle at the tips of the umbones, medially depressed; area in right valve low and broad, scarred with growth striae which are upcurved laterally. Outer surface for the most part decorticated. Traces of a fine and fairly regular concentric lamination still retained on a few individuals; radial sculpture indicated in a few shells by a feeble rippling toward the ventral margin. Lateral margins strongly dentate. Muscle scars obscure, the adductor probably subcentral and pyriform.

DIMENSIONS: Height of right valve (cotype), 53 millimeters; width, 25 millimeters; thickness, 5 millimeters. Height of left valve of another individual (cotype), 50 millimeters; width, 30 millimeters; thickness, 15 millimeters.

TYPE MATERIAL: Two cotypes, U. S. Nat. Mus. 372917.

TYPE LOCALITY: U.S.G.S. sta. 12968. Goat pens of east side of Yancy road, 3 miles north of Moore, Frio County, Texas. Mount Selman formation, Claiborne group.

The species is named for the collector, Douglas R. Semmes.

These small reef-making oysters apparently mark the top of the Bigford of Trowbridge. They are the probable equivalent of the reef-making oyster that outcrops southeast of Palafox between the Santo Tomas and the San Pedro coal seams and indicate a short incursion of the sea into that area. The Webb County oysters are heavier than those from Frio County, not so warped, and less rarely show a radial rippling upon the left valve.

Although *Ostrea semmesi* is not recorded on the Mexican side of the Rio Grande, it is introduced for purposes of comparison with the following species, *Ostrea gierharti*.

*Ostrea gierharti* Gardner, n. sp.

(Plate 2, figures 1-4)

Shell solitary, small, heavy, elongate ovate, attached by the beak of the convex left valve. Umbone of left valve drawn out and obtusely pointed, directed backward. Convexity of outer surface of left valve greater than that of the inner because of umbonal thickening. Right valve relatively thin, warped, with a low broad hinge area twisted backward. Ligament area in left valve high and narrow, depressed medially, very low in the right and slightly elevated medially. Only the ventral portion of the ligament area in the left valve functioning, the dorsal portion abandoned with the growth of the shell. Outer surface decorticated; faint traces of a radial threading still visible on some individuals; component concentric layers usually traceable across the valve. Submargins dentate. Muscle scars obscure.

DIMENSIONS: Height of left valve (cotype), 35 millimeters; width, 20 millimeters; thickness, 15 millimeters. Height of right valve of another individual (cotype), 23 millimeters; width, 15 millimeters; thickness, 7 millimeters.

TYPE MATERIAL: Cotypes, U. S. Nat. Mus. 372916.

TYPE LOCALITY: U.S.G.S. sta. 12972, Mexican side of Rio Grande across from San Ygnacio, Zapata County, Texas. Lower part of Mount Selman formation of the Claiborne group.

I have the pleasure of naming this species in honor of the collector G. B. Gierhart, of the Humble Oil & Refining Company.

The species is well characterized by the short, heavy shell and the pronounced but uniform thick-



ening of the left valve. The tips of the umbones are narrow and pointed, and the successive growth stages are recorded in the incremental lines of the left valve both on the disk and on the ligament fossette. *Ostrea gierharti* resembles *Ostrea thirsae* of the early Wilcox faunas, but the beaks of *O. thirsae* are broader and do not have the backward twist of those of *O. gierharti*. It may be even more closely allied to the gregarious *Ostrea semmesi* from the lower Mount Selman, 3 miles north of Moore, Frio County, Texas. The umbones of the left valve of *O. semmesi* are high and posteriorly directed, like those of *O. gierharti*, but they are not thickened.

DISTRIBUTION: Mount Selman formation: U.S.G.S. sta. 12972, Mexican side of Rio Grande across from San Ygnacio, Zapata County, Texas (Gierhart), also in the northeast bank of the Rio Grande at San Ygnacio (north of area covered by map); U.S.G.S. sta. 13989 (F-1); U.S.G.S. sta. 13988 (F-5).

### *Ostrea lisbonensis* Harris

(Plate 1, figures 20-22)

1919. *Ostrea sellaeformis*(?) var. *lisbonensis* HARRIS, Bull. Am. Paleontology, vol. 6, p. 12, pl. 9, figs. 1-6.

"We have never felt satisfied with the general reference of this form to *sellaeformis* and have long kept it apart from Conrad's species in our collections under the designation of *lisbonensis*. It occurs large and well defined at Lisbon, Ala., but it is in Louisiana where it is typically and extensively developed. When adult, it reaches about one-half the dimensions of the large *sellaeformis* in the bluff at Claiborne. The coarse plications, aviculoid form, posterior emargination and convexity of both valves which, by the way, are of a thick, dense make-up, distinguish it from the thin, nearly flat, multicostate, less aviculoid, less emarginate and early kinked young and adolescent individuals of *sellaeformis*.

"Type.—Paleont. Mus. Cornell Univ.

"Horizon.—St. Maurice Eocene.

"Specimens figured.—Chestnut, La.; Harris Collection, now deposited at Cornell." Harris, 1919.

The left valve of *O. lisbonensis* is closely plicate, and, at the resting stages, the edges of the laminae are free so that in many specimens the radial sculpture appears as a series of shelly frills. The right valve is unusually heavy especially in the umbonal region and free from any trace of radial sculpture, but the growth stages are strongly marked. The posterior dorsal margin of the adult is, as a rule, clearly alate, and a well-defined depression isolates the posterior wing from the disk. The heavy but not large shell, the alate outline, and the close radial sculpture of the left valve separate *Ostrea lisbonensis* from other members of the group such as *O. sellaeformis*.

Few species seem more consistently to occupy a limited time interval over a relatively wide area. At Lisbon Bluff, 6 miles above Claiborne Landing on the Alabama River, *Ostrea lisbonensis* occurs in abundance in bed no. 6 (17 of the Smith section) (Geol. Survey Alabama, Rept. Geology of the Coastal Plain Alabama, p. 130, 1894), and the equivalent bed no. 4 of the Cooke section (Geol. Survey Alabama, Spec. Rept. 14, p. 270, 1926). There is no record of it at a higher level. *Ostrea sellaeformis* Conrad is not found below bed no. 13 of the Smith section. The two horizons are separated by an interval of 25 or 30 feet.

Harris has noted the abundance of this species in Louisiana. In Texas, *Ostrea lisbonensis* has a meager representation in the upper part of the Weches member of the Mount Selman formation in San Augustine, Houston and Anderson counties. In Mexico, in northeastern Nuevo León, a thin bed packed with *O. lisbonensis* occurs at an equivalent horizon, a little below the top of the Mount Selman. The remnants of this old *lisbonensis* reef have been recovered at several localities in Santa Ana and possibly in Carlos Cantú. As at Claiborne Bluff, the horizon is consistently lower than that at which *Ostrea sellaeformis* is abundantly represented. *Ostrea smithvillensis*, common in the Weches member of the Mount Selman formation of Texas, has no known representation in Mexico.

The figured left valve, U. S. Nat. Mus. 495998 (from U.S.G.S. sta. 13635), measures 40 millimeters in height and 28.5 millimeters in width; the immature right valve, U. S. Nat. Mus. 495997 (from U.S.G.S. sta. 13630), 35.5 millimeters in height and 24 millimeters in width.

DISTRIBUTION: Mount Selman formation: U.S.G.S. sta. 13603 (H-15); U.S.G.S. sta. 13622 (L-23); U.S.G.S. sta. 13589 (L-23); U.S.G.S. sta. 13623 (L-24); U.S.G.S. sta. 13626 (L-24); U.S.G.S. sta. 13635 (M-24); U.S.G.S. sta. 13630 (M-25).



*Ostrea sellaeformis* Conrad

- Dec. 1832. *Ostrea sellaeformis* CONRAD, Fossil shells of the Tertiary formations of North America, vol. 1, no. 2, p. 27, pl. 13, fig. 2 (right valve).  
 Dec. 1832. *Ostrea radians* CONRAD, Fossil shells of the Tertiary formations of North America, p. 27, pl. 13, fig. 1 (left valve).  
 1842. *Ostrea sellaeformis* CONRAD, Nat. Inst. Washington, Proc., Bull. 2, p. 192, pl. 1, fig. 1.  
 1884. *Ostrea sellaeformis* CONRAD. HEILPRIN in WHITE, U. S. Geol. Survey, 4th Ann. Rept., p. 311, pl. 62, figs. 1, 2; pl. 63, fig. 1.  
 1890. *Ostrea sellaeformis* CONRAD. DE GREGORIO, Annales de géologie et paléontologie, t. 8, p. 175, pl. 19, figs. 11-12.  
 1898. *Ostrea sellaeformis* CONRAD. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 677. (Synonymy excluded.)  
 1901. *Ostrea sellaeformis* CONRAD. CLARK AND MARTIN, Maryland Geol. Survey, Eocene, p. 192, pls. 48, 49.  
 1919. *Ostrea sellaeformis* CONRAD. HARRIS, Bull. Am. Paleontology, vol. 6, p. 10, pl. 6, figs. 2-12; pl. 7.  
 1931. *Ostrea sellaeformis* CONRAD. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 104.  
 1936. *Ostrea sellaeformis* CONRAD. STENZEL, Univ. Texas Bull. 3501, p. 276.

"Oblong, convex, thick and ponderous, lobed; one side of the larger valve profoundly sinuous and the opposite side gibbous; smaller valve sinuous and little convex; dorsal margin long and slightly arched, with both extremities obtusely rounded.

"Localities.—Claiborne, Ala. Middle Tertiary.

"This singular shell does not vary greatly in its outline, and is very unlike any other species of this country with which we are acquainted. It is often extremely thick and ponderous." Conrad, 1832.

Conrad obviously was describing the cover valve. The description of the attached valve immediately precedes on the same page and is headed *Ostrea radians*. It is to be hoped that no overzealous advocate of the law of priority will attempt on this ground to supplant the deeply entrenched and most fitting name of *sellaeformis*.

The typical ponderous saddle-shaped oyster that goes by the name of *sellaeformis* and was described from the Lisbon horizon on the Alabama River is represented in the collections of the National Museum from Coffeeville, Alabama (U.S.G.S. sta. 2870); Claiborne Bluff, Alabama River, Alabama (U.S.G.S. sta. 263, lower bed of section), and Wautubbee Hills, Enterprise, Clarke County, Mississippi (U.S.G.S. sta. 2616 and 3092).

Specimens from City Point, Virginia (U.S.G.S. sta. 6355), and Coggins Point (U.S.G.S. sta. 1577) are not quite so massive as the heaviest specimens from the Gulf, but they show the characteristic outline and radial umbonal sculpture.

In Texas records of typical *sellaeformis* are exceedingly rare, and Stenzel's discovery (Univ. Texas Bull. 3501, p. 276, 1936) of an old *sellaeformis* reef overlying a thin conglomerate of glauconitic limestone pebbles at Stone City, Burleson County, Texas, is of unusual significance. The species at Stone City is represented by massive forms similar to those which characterize the littoral facies at the base of the upper Lisbon in Alabama and Mississippi. The bed has no known counterpart in east Texas or in south Texas. Stenzel has established the position of the bed at the base of the "Crockett marl", a horizon analogous probably to that of the *sellaeformis* bed at the base of the bluff at Claiborne, Alabama.

In Mexico conditions were highly favorable, and a reef of exceptionally well characterized *Ostrea sellaeformis* has been used as a key bed to the basal part of the Laredo formation.

With it are associated many solitary corals referable to *Balanophyllia* and *Flabellum*. For some reason, possibly because it occupies a slightly lower position in the stratigraphic section, *O. sellaeformis* has not been found with *O. contracta amichel*, abundant in the Mier section, but is confined, apparently, to faunas of a slightly different facies in Nuevo León.

DISTRIBUTION: Laredo formation: lower Laredo, U.S.G.S. sta. 13562 (H-12); U.S.G.S. sta. 13560 (H-12); U.S.G.S. sta. 13563 (H-12); U.S.G.S. sta. 13596 (H-15); U.S.G.S. sta. 13599 (H-15); U.S.G.S. sta. 13602 (H-16); U.S.G.S. sta. 13552 (I-16); U.S.G.S. sta. 13618 (H-17); U.S.G.S. sta. 13617 (H-18); U.S.G.S. sta. 13597 (I-18); U.S.G.S. sta. 13969 (I-19); U.S.G.S. sta. 13970 (I-19); U.S.G.S. sta. 13971 (I-20); U.S.G.S. sta. 13967 (J-20); U.S.G.S. sta. 13620 (L-23).



*Ostrea contracta* Conrad

1855. *Ostrea contracta* Conrad, Acad. Nat. Sci. Philadelphia, Proc., vol. 7, p. 269.  
 1857. *Ostrea contracta* CONRAD, in EMORY, Report U. S. and Mexican Boundary Survey, vol. 1, pt. 2, p. 160, pl. 18, fig. 1 a-d.  
 1898. *Ostrea georgiana* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 683 (part).  
 1919. *Ostrea alabamiensis* var. *contracta* Conrad. HARRIS, Bull. Am. Paleontology, vol. 6, p. 9, pls. 3, 4; pl. 5, fig. 2.  
 1923. *Ostrea alabamiensis* subsp. *georgiana* Conrad. GARDNER in TROWBRIDGE, U. S. Geol. Survey, Prof. Paper 131-D, p. 110, pl. 29, figs. 6, 7; pl. 30.

"Subfalcate, elongated; cavity shallow and remarkably contracted near the hinge. Length nearly two feet.

"*Locality*.—Oyster Point, near Mier, Mexico." Conrad, 1855.

"Subfalcate, elongate, thick; exterior of lower valve very irregular, and varying from ventricose to flat; cavity shallow and remarkably contracted towards the hinge, which is elongated, having a deep and broad cavity in the lower valve, with a corresponding rounded and striated ridge in the opposite valve.

"This large oyster measures nearly two feet from beak to base. The contracted form of the cavity is most striking in the oldest individuals. Probably a Miocene shell.

"*Locality*.—Oyster Point, Mexico." Conrad, 1857.

Oyster Point is not a current name, and no mention of it has been found in the report on the Lower Rio Bravo by the collector, Major William H. Emory. However, he did mention a locality possibly identical with the Oyster Point of Conrad. In the discussion of the islands in the Rio Grande, he wrote (Emory, 1857, p. 66):

"Five miles above Roma, and opposite Mier, there is a large island called Los (Las) Adjuntas, which was awarded to the Mexican side. . . . If any difference is to be noted in the zoological character of these rocks it is in the exposure, just above Roma, at the foot of the island of Las Adjuntas, and at several other localities in the neighborhood, of banks of fossil oyster-shells of great size, some of them measuring 18 inches in length."

Conrad's type is U. S. Nat. Mus. 9904. The figures in the Report of the Mexican Boundary Commission are not good. The larger left valve is bent and broken at the ventral extremity so that it is difficult to give the exact length. The width of the left valve is about 150 millimeters, the thickness about 40 millimeters. The smaller right valve is also broken at the ventral extremity but may easily have reached 18 inches. The width is 115 millimeters, the thickness about 40 millimeters.

Similar greatly elongated oysters were described by Conrad under the name of *georgiana*, and this name was used for the Embayment oysters in the 1923 report. It is abandoned because the common middle and upper Eocene oysters of the Embayment region seem to represent a single stock, those of the Yegua and Jackson grading downward with only an arbitrary break into the much shorter ovate-trigonal oyster of the Laredo formation. If the Laredo form is a species distinct from that of the eastern Gulf, as it seems to be, the later titans probably evolved *in situ*, and the similarity to the oysters of the eastern Gulf and Atlantic Seaboard is fortuitous. A very small percentage, however, of *Ostrea contracta* retain a fine epidermal sculpture similar to that of *Ostrea alabamiensis*.

In the large mass of material available for study—several hundred individuals—certain differences in the average of the individuals developed at the different horizons can be detected. There is a progressive increase in the average size and weight in passing from the Laredo formation through the Yegua formation to the Jackson group, but there is also an overlap of the end members. Shallow-water conditions must have continued with only slight interruption in the Laredo and Roma-Mier sectors, for in that area both *Ostrea contracta* and *O. amichel* are reef making throughout their stratigraphic range.

*Ostrea contracta amichel* Gardner, n. subsp.

(Plate 3, figures 1, 2)

*Ostrea alabamiensis* of authors.

Not *Ostrea alabamiensis* LEA, Contributions to geology, p. 91, pl. 3, fig. 71, 1833.

Shell moderately large, elongate ovate-trigonal; heavy, laminated, the component lamellae visible in cross section along the lateral margins. Outer surface not preserved. Umbones relatively narrow,



inclined toward the posterior lateral margin in the types, becoming increasingly produced ventrally and increasingly thickened with the growth of the shell. Body cavity small. Adductor scar distinct, sunken, placed far forward. No trace of vermicular markings retained along the lateral margins.

DIMENSIONS: Right valve, height, 135 millimeters; width, 77 millimeters; thickness, 25 millimeters. Left valve of another individual, height, 140 millimeters; width, 78 millimeters; thickness, 37 millimeters.

COTYPES (a right and a left valve of different individuals): U. S. Nat. Mus. 496573.

TYPE LOCALITY: U.S.G.S. sta. 14057, 1½ miles north of the crossing of Highway 80 over Arroyo Dolores, Webb County, Texas. Laredo formation, Claiborne group.

The description of a new oyster from the middle Eocene of the Rio Grande Embayment places the author upon the defensive. *Ostrea contracta amichel* has for many years been well known under the name of *Ostrea alabamiensis* Lea, described from a valve from the Gosport sand. The larger and more massive oysters of the later Eocene of the Embayment have been considered a subspecies of *alabamiensis*. Lea's type and all the available material observed at the type locality are thin shells, not conspicuously laminated, nor with conspicuously powerful hinges. The reef-making oyster of the middle Eocene of the Rio Grande Embayment is a much heavier shell, conspicuously laminar especially around the beaks and with a hinge area which is both lengthened and strengthened with the growth of the shell. *Ostrea alabamiensis* Lea has not been recognized in the lower Claiborne of Alabama. *Ostrea contracta amichel* is a reef-making species in the middle and upper Laredo formation of the lower Claiborne group. However, it has never been found, in either the eastern or the western Gulf in association with *sellaeformis* Conrad, and there is little evidence that the relatively rare thin-shelled *Ostrea alabamiensis* described by Lea from the Gosport sand is a form of *amichel* living under an unfavorable environment.

*Ostrea contracta* Conrad, s.s., is probably a descendant of the subspecies *amichel*, and the intergrading characters in the western Gulf of the lower Claiborne, upper Claiborne, and Jackson races are evidence for a direct line from *amichel* to *contracta* s.s. rather than indirectly through a third species from the eastern Gulf and of upper Claiborne age. The possibility that *Ostrea frionis* Harris might be available for the Embayment species was considered, but *frionis* seems a thinner shell with relatively few laminae and those free-edged and rippled. The lower Eocene oysters have proved surprisingly trustworthy guide fossils, and the apparent lack of significance of the later Claiborne and Jackson oysters may be due in large measure to their former grouping. *Ostrea contracta amichel* includes the heavy, laminated, ovate-trigonal oysters confined in their known distribution to the Claiborne of the Rio Grande Embayment and abundant only in south Texas and in the Mier sector of northeastern Mexico.

DISTRIBUTION: Laredo formation: upper Laredo, U.S.G.S. sta. 13767 (G-3); U.S.G.S. sta. 13766 (G-4); U.S.G.S. sta. 13771 (H-3); U.S.G.S. sta. 13944 (H-3); U.S.G.S. sta. 13943 (H-3); U.S.G.S. sta. 13945 (H-3); U.S.G.S. sta. 13542 (J-13); U.S.G.S. sta. 13545 (J-15). Yegua formation: U.S.G.S. sta. 13937 (H-3); U.S.G.S. sta. 13938 (H-3); U.S.G.S. sta. 13939 (H-3); U.S.G.S. sta. 13940 (H-3); ? U.S.G.S. sta. 13941 (H-3); U.S.G.S. sta. 13942 (H-3); U.S.G.S. sta. 13951 (H-3); U.S.G.S. sta. 13952 (H-3); U.S.G.S. sta. 13954 (H-3); U.S.G.S. sta. 13646 (H-3); U.S.G.S. sta. 13964 (H-6); U.S.G.S. sta. 13733 (J-7); U.S.G.S. sta. 14022 (J-7); U.S.G.S. sta. 13966 (J-7).

#### *Ostrea* sp.

Poorly preserved oysters are present in considerable numbers at a few localities in the lower part of the marine Oligocene of northeastern Mexico. Some of them are more than 6 inches long. They are narrower than *O. trigonalis* Conrad and not so heavy; less strongly plicate than *haitensis* Sowerby; closest, possibly, to *Ostrea contracta* Conrad, but less massive, broader than the average *contracta*, and with a more convex left valve. Such oysters have been collected at U.S.G.S. sta. 13518 (N-10); U.S.G.S. sta. 13521 (M-10); and U.S.G.S. sta. 13509 (M-11).

#### *Ostrea frithi* Gardner, n. sp.

(Plate 2, figures 7, 9)

Shell of moderate dimensions, fairly heavy, both valves convex but the left more so than the right. Area of attachment on the left valve usually large. Beaks high and pointed, orthogyrate or twisted



slightly backward. Ligament area low and broad in the right valve, in the left valve very high, subacutely tapering, but only the ventral portion functioning, the dorsal portion abandoned in the growth of the shell. No pronounced thickening at the umbones; the entire shell crowded with closely overlapping lamellae, with little or no trace of a radial plication. Submargins dentate. Adductor scar large, the outline obscured by the weathering of the shell.

**DIMENSIONS OF HOLOTYPE:** Height, 109 millimeters; width, 36 millimeters; thickness, 40 millimeters.

**TYPE MATERIAL:** Holotype, U. S. Nat. Mus. 372918.

**TYPE LOCALITY:** U.S.G.S. sta. 12969, oyster bed in southwest corner of the Antonio Canales Salinas, "Sacatosa" Grant, northwestern part of Starr County, 20 miles north of Roma, Starr County, Texas. Collectors, G. B. Gierhart and F. C. Owens.

**HORIZON:** Upper part of the Jackson formation.

The species is named for the collector, Mr. Frith C. Owens, of the Humble Oil & Refining Company.

*Ostrea frithi* is remarkable for the strong convexity of the valves, the high and narrow ligament area in the left valve, and the crowded concentric lamination.

In Texas, the species has been recognized only at the type locality.

### *Ostrea* sp.

(Plate 2, figure 5; Plate 4, figure 5)

A number of left valves characterized by the deep ovate outline of the interior and the high narrow hinge area were recovered from the gypsiferous clays between the marine Oligocene sandstones at U.S.G.S. sta. 13502 (N-7). They resemble *Ostrea frithi* from the upper Jackson of Starr County, Texas, but are less heavy and less compressed laterally. The figured specimen, U. S. Nat. Mus. 499278, is 104.5 millimeters high and 57 millimeters wide; the depth of the valve is 43 millimeters.

### *Ostrea trigonalis* Conrad

1854. *Ostrea trigonalis* Conrad. WAILES, Rept. agriculture and geology of Mississippi, p. 289 (name only), pl. 14, fig. 10.

1855. *Ostrea trigonalis* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 7, p. 259.

1898. *Ostrea trigonalis* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 681.

"Triangular flat, surface irregular with some indistinct radiating lines; muscular impression obliquely suboval, situated nearer the summit than the base. Margin somewhat ascending, submargin crenulated." Conrad, 1855.

**LOCALITY:** Jackson, Mississippi.

*Ostrea trigonalis* Conrad is fairly heavy and varies widely in outline. The umbones are generally subcentral and fairly straight, the hinge area in the right valve relatively broad and very flat, with a shallow central depression; that of the left valve relatively narrow, high, and trigonal. The strong vermicular sculpturing of the submargins in front of the hinge area, particularly in the right valve, forms one of the best diagnostics of the species. The outer surface of the heavy upper valve is coarsely wrinkled; that of the lower valve may be smooth, sculptured with coarse growth lines, or rudely plicated. The muscle scar is semioval and often deeply impressed. Its position is not usually so high as one might suppose from Conrad's description.

Rather small, flattish valves with the characteristic vermicular markings, small hinge area, and large muscle scar of *Ostrea trigonalis* Conrad are common at U.S.G.S. sta. 13516 (M-12). There is no associated fauna, but the horizon seems to be high in the Jackson formation.

### *Ostrea vicksburgensis* Conrad

Jan., 1848. *Ostrea vicksburgensis* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 3, p. 296.

Aug., 1848. *Ostrea vicksburgensis* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 126, pl. 13, figs. 5, 37.

1884. *Ostrea vicksburgensis* Conrad. HEILPRIN in WHITE, U. S. Geol. Survey, Ann. Rept., vol. 4, p. 312, pl. 63, figs. 2, 3.

1898. *Ostrea vicksburgensis* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 682.



1906. *Ostrea vicksburgensis* Conrad. VEATCH, U. S. Geol. Survey, Prof. Paper 46, pl. 23, figs. 1, 1a-b.  
 1917. *Ostrea vicksburgensis* Conrad. HOPKINS, U. S. Geol. Survey, Bull. 661-H, p. 299, pl. 27, fig. 2.  
 1926. *Ostrea vicksburgensis* Conrad. COOKE, in Geol. Survey Alabama, Spec. Rept. 14, pp. 279, 280, 282-285, 288, 290, 292, pl. 97, fig. 4.

"Plicated; very irregular and adhering, the upper valve not flat, but swelling in an irregular manner. Height  $1\frac{3}{4}$ ."

"There is nothing peculiar about this shell, yet it is clearly distinct from any other species of the American Tertiary hitherto described. Common." Conrad, 1848.

*Ostrea vicksburgensis* is a relatively small thin species, commonly rather broad and lopsided, with perhaps a dozen strong sharp plicae on the attached left valve, and fewer and feebler folds on the right. There is a certain increase in the number of folds by anastomosing and intercalation. The major folds on the left valves usually spring from the umbones; those of the right valve have a later origin.

*Ostrea vicksburgensis* ranges throughout the Oligocene.

In Mexico the species has been collected from the middle and upper Oligocene sandstone at U.S.G.S. sta. 13532 (O-19), U.S.G.S. sta. 13582 (O-25), and U.S.G.S. sta. 13581 (P-25).

#### *Ostrea* sp. cf. *O. normalis* Dall

Synonymy and description of *Ostrea normalis* Dall:

1898. *Ostrea georgiana*, forma *normalis* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 684.  
 1915. *Ostrea mauricensis* Gabb? DALL, U. S. Nat. Mus., Bull. 90, p. 123 (part). Not *Ostrea mauricensis* Gabb, 1860.  
 1926. *Ostrea normalis* Dall. GARDNER, U. S. Geol. Survey, Prof. Paper 142-A, p. 43, pl. 11, figs. 3-4.

"The typical *O. georgiana* are the enormous senile specimens with shells ranging to 2 feet long and 3 or 4 inches thick. The young and really more normal specimens have been overlooked, though much more abundant, or referred to other species, chiefly *O. virginica*, from which they differ by their more elongated, usually straight, deeply excavated cardinal area and the absence of ribbing on the lower valve in most specimens." Dall, 1898.

DIMENSIONS: Right valve, height, 95.0 millimeters; width, 55.0 millimeters. Left valve of another individual, height 100.0 millimeters; width, 50.0 millimeters.

COTYPES: U. S. Nat. Mus. 153848.

TYPE LOCALITY: No. 323, Devil's Mill Hopper near Hawthorn, Alachua County, Fla. Hawthorn formation.

Shell solid, usually thick, elongated ovate-trigonal in outline, sometimes very narrow and rudely elliptical. Right valve flattened. Left valve feebly convex. Umbones narrow and compressed, erect or slightly inclined. Component concentric layers usually visible both on the disk and along the lateral margin, most expanded, as a rule, a little more than half way down from the dorsal to the ventral margin, thus giving to the exterior a pseudoconvexity which the interior does not possess; concentric laminae probably frilled much as in *O. compressirostra* Say but with the free edges commonly broken. Ligament area usually high and narrow, strongly depressed medially in the left valve, conspicuously elevated in the right, especially toward its ventral extremity. Lateral margins well differentiated both by the change in the plane of the hinge and in the direction of the incrementals; vermicular sculpture rarely developed upon the submargins. Single muscle scar semi-elliptical, deeply excavated in the heavier individuals, slightly posterior and ventral in position.

Oysters resembling *Ostrea normalis* Dall are abundant in the Miocene at U.S.G.S. stas. 13577 (R-26) and 13578 (U-25). They are of no more than moderate dimensions but unusually thick, with deeply sunken adductor scars. The state of preservation is indifferent, and the reference to the lower Miocene Floridian species is uncertain.

#### *Ostrea* sp. cf. *O. cahobasensis* Pilsbry and Brown

Synonymy and description of *Ostrea cahobasensis* Pilsbry and Brown:

1917. *Ostrea cahobasensis* PILSBRY AND BROWN, Acad. Nat. Sci. Philadelphia, Proc., p. 40, pl. 6, fig. 8.

"This oyster is similar to the preceding [*Ostrea vaughani insularis* Pilsbry and Brown] except that in a large series of specimens none were found to have the inner margins of the valves denticulate near



the hinge. The upper valve is nearly flat and is perhaps somewhat rougher than in *insularis*. Length 85 mm. It often reaches a much larger size, length 190 mm. or more.

"Haiti, in the mountains north of Lake Assuei, on the trail to Las Cahobas, W. W. Webster; Arrondissement de Las Cahobas, G. Roumain; also south of Thomonde, Lloyd B. Smith. Occurs in extensive beds composed almost wholly of oysters.

"Type No. 1308, A.N.S.P." Pilsbry and Brown, 1917.

An oyster roughly 11 centimeters in height by 7 centimeters in width is abundant at a number of stations along the Oakville scarp in Tamaulipas. The lateral margins converge only feebly toward the hinge. The hinge area of the right valve is very flat and almost as broad as the shell; that of the left valve is higher and tapers dorsally. No trace of vermicular markings along the lateral margins has been observed, but these may have been lost together with the characters of the surface sculpture. The muscle scar is moderately impressed and lies entirely within the ventral half of the shell.

The species represented is distinct from *Ostrea normalis* Dall. The shells are larger, but they are less laminated and relatively less thick. The lateral margins are more nearly parallel, so that the shell does not present the ovate-trigonal outline of those from U.S.G.S. sta. 13577 (R-26), referred doubtfully to *Ostrea normalis*. Topotypes of *cahobasensis* in the collections of the U. S. National Museum are much larger than the specimens from Tamaulipas, and it is doubtful if the two series are specifically identical. However, the Mexican form certainly approaches more closely to the Haitian shells than to any described Floridian species.

DISTRIBUTION: Oakville sandstone: U.S.G.S. sta. 14038 (R-14); U.S.G.S. sta. 14039 (R-14); U.S.G.S. sta. 14041 (S-15); U.S.G.S. sta. 13608 (S-20); U.S.G.S. sta. 13573 (U-23).

#### *Ostrea* sp.

A large but poorly preserved oyster is abundant in the Oakville sandstone at U.S.G.S. sta. 13608 (S-20). The shells suggest *Ostrea cahobasensis* Pilsbry and Brown (Acad. Nat. Sci. Philadelphia, Proc., p. 40, pl. 6, fig. 8, 1917). The left valve is rather strongly convex, possibly laminated concentrically; the right valve is flattened and ovate. The ligament area was probably rather broad and, in the right valve at least, oriented in a vertical plane. The heavy shell, apparent simplicity of sculpture, and broad straight hinge are the characteristic features which have been retained in the fragmentary specimens.

### Order ANOMALODESMACEA

#### Superfamily ANATINACEA

#### Family PHOLADOMYIDAE

#### Genus *Pholadomya* Sowerby

1823. *Pholadomya* SOWERBY, Genera of Recent and fossil shells, fasc. 19.

TYPE, BY SUBSEQUENT DESIGNATION (GRAY, Zool. Soc. London Proc., pt. 15, p. 194, 1847): *Pholadomya candida* Sowerby. Recent in the West Indies.

Shell thin, nacreous, subequivalve, inequilateral; a slight antero-ventral and a pronounced posterior gape. Outline transversely ovate-trigonal to subquadrate, the beaks commonly inflated and prominent and the tips so closely in contact that they impinge one against the other. Lunule and escutcheon simulated in some species by a flattening toward the dorsal margins of the valves and the disappearance of the sculpture. External ligament rather short but probably adequate for so thin a shell, the dorsal margin considerably thickened to function as an area of attachment; ligament occupying also a small, trigonal, subumbonal pit, the thin base of the pit in the right valve strengthened by a rib running obliquely forward from the tip of the umbone; anterior margin of pit in the left valve merging with the anterior dorsal margin, upturned along the forward outer edge. Hinge edentulous. Shell so thin that both the concentric and the radial sculpture developed upon the outer surface are reflected on the inner. Pallial and muscle scars obscure; the pallial sinus broad and moderately deep, the pallial line following rather close to the ventral margin.

The shell may be rippled concentrically as in *Clementia* and *Pteropsis*. The radials originate at the umbones; they are irregular and more or less noded at the intersection with the concentric ribbing. Secondaries may be fortuitous.



*Pholadomya* reached its apogee before the close of the Mesozoic. The Cenozoic species are few and, like other races of ancient lineage, widely scattered.

*Pholadomya claibornensis harrisi* Gardner

(Plate 6, figures 1-3, 8, 9, 12)

1919. *Pholadomya claibornensis* Aldrich. HARRIS, Bull. Am. Paleontology, vol. 6, p. 197 (part), pl. 59, fig. 9.  
Not *Pholadomya claibornensis* ALDRICH, 1886.  
1927. *Pholadomya (claibornensis subsp.?) harrisi* GARDNER, Washington Acad. Sci., Jour., vol. 17, no. 14, p. 367.

"Shell exceedingly thin, nacreous; oblong—trigonal, expanded anteriorly; the posterior dorsal margin approximately parallel to the base; the posterior extremity broadly rounded. Umbones full, prominent, nearly terminal, the tips incurved and in contact. Concentric folds rather coarse, strong and regular, though incremental in character; radials well developed upon the medial portion of the shell, absent upon the extreme anterior and over a slightly greater posterior area; discontinuous, inclined to be nodose at the intersection with the concentric rugae and obsolete in the interspaces. Characters of the hinge and interior not known." Gardner, 1927.

DIMENSIONS: Height, 22 millimeters; width, 30 millimeters. (Taken from drawing.)

HOLOTYPE: Cornell University, Ithaca, New York.

TYPE LOCALITY: 2 miles east of Alto, Cherokee County, Texas. Weches member of the Mount Selman formation.

The specimens from the western Gulf were separated from those from Alabama because of the stronger and more persistent radial sculpture and apparently coarser concentric markings. In Texas, *Pholadomya claibornensis harrisi* has been recovered both from the Weches member of the Mt. Selman formation and from the Cook Mountain and Laredo formations. In northeastern Mexico it is reported only from the Laredo but it is more widely distributed than it is in Texas, possibly because the waters were a little warmer and, therefore, more favorable.

Dimensions of figured imperfect specimen from U.S.G.S. sta. 13560, U. S. Nat. Mus. 496114: Height, 27 millimeters; width, 39 millimeters; convexity of double valves, 22.3 millimeters. Figured imperfect specimen from U.S.G.S. sta. 13967, U. S. Nat. Mus. 496115: Height, 16 millimeters; width, 26 millimeters. Figured imperfect specimen from U.S.G.S. sta. 13570, U. S. Nat. Mus. 496116: Height, 20 millimeters; width, 20 millimeters; convexity of double valves, 16.5 millimeters. Figured imperfect specimen from U.S.G.S. sta. 13556, U. S. Nat. Mus. 496261: Height, 21 millimeters; width, 22 millimeters; convexity of double valves, 17 millimeters.

DISTRIBUTION: Laredo formation: lower Laredo, U.S.G.S. sta. 13560 (H-12); U.S.G.S. sta. 13967 (J-20); middle Laredo, U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13547 (I-14); U.S.G.S. sta. 13556 (I-14).

Family THRACIIDAE

Genus *Thracia* (Leach Ms) De Blainville

1824. *Thracia* (Leach Ms) DE BLAINVILLE, Dictionnaire des sciences naturelles, vol. 32, p. 347.  
1825. *Thracia* (Leach Ms) DE BLAINVILLE, Manuel de malacologie et de Conchyliologie, p. 564.  
1827. *Thracia* DE BLAINVILLE, Manuel de malacologie et de Conchyliologie, Planches, p. 660, pl. 76, fig. 7.  
1839. *Thracia* Leach. COUTHOUY, Boston Jour. Nat. History, vol. 2, p. 129.  
1903. *Thracia* Blainville. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 6, p. 1522.

TYPE, BY ELIMINATION: *Thracia corbuloidea* De Blainville. Recent in the Mediterranean.

The shell of *Thracia* is thin, not nacreous but cellulo-crystalline, transversely ovate to ovate-trigonal, broadly rounded in front, more or less produced, truncate, and gaping posteriorly. The right valve is larger and more inflated than the left, the right umbone higher, and the ventral margin of the right valve extending beyond that of the left. The umbones are broad, placed a little in front of the medial line, inrolled and at the extreme tips turned slightly backward. They are so closely in contact in some of the species, notably *Thracia conradi* Couthouy, that the shell is frequently worn through by friction of the opposing surfaces. The anterior lateral margin is, as a rule, broadly rounded, the ventral margin broadly constricted in front of the obtuse rostrum, and the posterior



truncate or rounded. The only sculpture is a concentric wrinkling, incremental in character, and a surficial granulation. The living species are in some degree protected by a delicate periostracum. The ligament is short, marginal, and sunken. It is attached on either side to modifications of the posterior dorsal margins which in the closed valves are spoon-shaped. The hinge is edentulous. In some species the inner extremity of the anterior dorsal margin of the left valve is raised into an inconspicuous subumbonal tubercle, and in other species an inconspicuous ossicle is developed upon the anterior dorsal margin a little in front of the umbone. In most of the *Thracia* the shell is so thin that the muscle scars and moderately insinuated pallial line are difficult to observe.

*Thracia* is reported from the early Mesozoic to the Recent. The Tertiary species, like the Recent species, are widely scattered, but individuals are rarely abundant. Many of the East Coast American forms are associated with northern faunas.

*Thracia?* sp.

(Plate 7, figures 7, 8)

A mold of the locked double valves with fragments of a thin shell adhering may be referable to *Thracia*. The valves are somewhat warped, especially the right which is broadly but not strongly inflated anteriorly and broadly depressed posteriorly. In the left valve, the inflation is more evenly distributed, and there is no posterior depression. The umbones are small, pointed, turned backward, proximate, posterior but not conspicuously so. There is no lunule and no escutcheon. The posterior dorsal margin is short and depressed, the anterior obliquely produced to unite with the upcurved arc of the ventral and lateral margins; the short posterior end is broadly and almost vertically truncate. There was probably a posterior gape, but the valves are in close contact anteriorly. The only sculpture is incremental with possibly a faint radial hachuring. The characters of the interior are not accessible.

DIMENSIONS OF FIGURED SPECIMEN: Height, 20 millimeters; width, 26.5 millimeters; convexity of double valves, 10.5 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 495999.

Locality: U.S.G.S. sta. 13569 (H-12), General Bravo, Carlos Cantú, Nuevo León. Middle part of Laredo formation. Claiborne group.

The shell is described because it may be recognized when next observed by its transverse outline and short, squarely truncate, posterior end.

Subgenus *Cyathodonta* Conrad

1849. *Cyathodonta* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., 1st ser., vol. 4, p. 155.

TYPE BY MONOTYPY: *Cyathodonta undulata* Conrad. Recent in the Gulf of California.

The species of the subgenus are smaller than *Thracia s. s.* The inequality of the valves, at least in the subgenotype, is more marked, and the thin shells are rather strongly and more or less obliquely rippled. The umbones are entire. The hinge plate is continuous and not cleft as it is in *Thracia s. s.* The ligament is marginal in front of and behind the beaks, but there is also a short internal ligament supported on the thickened segment of the hinge plate which forms the resilifer. The anterior margin of the resilifer is buttressed and drops vertically from the tip of the umbones; the posterior margin is also buttressed and parallel to the dorsal margin. The pallial sinus in the subgenotype is broad and horizontally directed; its rounded anterior margin is approximately in line with the umbones.

*Cyathodonta* has not been formerly reported in strata older than the Vicksburg. The Recent species are widely distributed in the warmer waters.

*Thracia (Cyathodonta)* sp. cf. *T. (C.) vicksburgiana* Dall

Synonymy and description of *Thracia (Cyathodonta) vicksburgiana* Dall:

1903. *Thracia (Cyathodonta) vicksburgiana* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 6, p. 1526, pl. 57, fig. 27.

"Shell elongate, the right valve convex, the anterior end longer, slightly attenuated, and evenly rounded; posterior end shorter, rather abruptly vertically truncated, compressed above with a rounded ridge extending from the beak to the lower posterior angle; beaks low, somewhat recurved,



situated at about the posterior third; surface with numerous nearly concentric subequal ripples, fading out behind the vertical of the beaks and each about one millimetre wide. Length 33.5, height 19.0, diameter of right valve about 6.0 mm.

"A single well-preserved internal cast in a fine-grained limestone is in the collection labelled as from Vicksburg, Mississippi, on the authority of J. B. Marcou. It is more nearly like the average typical *Thracia* in form than are the more recent *Cyathodonta*." Dall, 1903.

A specimen from the upper Jackson at U.S.G.S. sta. 13515 (M-12), Zacate, Nuevo León, seems closely related to *vicksburgiana* though not conspecific. It is smaller than Dall's species and more compressed. The basal margin seems more strongly arched, and the posterior area less flaring, but the general outline and sculpture pattern are similar in the Mexican and Mississippi shells.

#### Superfamily POROMYACEA

#### Family CUSPIDARIDAE

#### Genus *Cuspidaria* Nardo

1840. *Cuspidaria* Nardo, Revue zoologique par la Société Cuvierienne, Jour. mensuel, January, p. 30.

TYPE, BY MONOTYPY AND ORIGINAL DESIGNATION: *Tellina cuspidata* Olivi. Recent in the Mediterranean.

Shell thin, fragile, transversely pyriform, feebly inequivalve, strongly inequilateral, the anterior portion of the shell inflated, the posterior abruptly constricted and compressed, squarely truncate, gaping slightly for the extrusion of the siphons. Ligament internal, attached to a vertical or posteriorly directed subumbonal chondrophore. A laminar posterior lateral, elongated parallel to the dorsal margin, commonly developed in the right valve; an anterior lateral and an anterior and a posterior cardinal more rarely developed. A buttress for the support of the posterior adductor developed in some of the subgenera.

*Cuspidaria* has been reported from the Jurassic, and the subgenus *Cardiomya* from the Cretaceous. The Recent species exhibit a geographic and bathymetric range associated with long-established groups. Dall, who studied the Blake dredgings, observed that recent *Cardiomya* flourished in warm and relatively shallow waters, the smooth *Cuspidaria* in colder and deeper waters.

#### Subgenus *Cardiomya* A. Adams

1864. *Cardiomya* A. ADAMS, Annals Mag. Nat. Hist., 3d ser., vol. 13, p. 208.

TYPE, BY MONOTYPY: *Neaera gouldiana* Hinds. Recent in the seas of Japan.

*Cardiomya* is known by the radiating sculpture and by the chondrophore which is less obliquely inclined toward the posterior margin than in *Cuspidaria*, s. s.

#### *Cuspidaria (Cardiomya) vieja* Gardner, n. sp.

(Plate 5, figure 8)

Shell small, highly inflated medially and anteriorly, the posterior portion compressed and produced so that the shell suggests a minute crucible with a small flat handle. Umbonal region sharing the inflation, the tips turned inward and not conspicuous. Shell sharply constricted behind the umbones and produced into a narrow rostrum. Entire outer surface closely threaded, the threads a little less crowded upon the slightly concave posterior area and most conspicuous upon the keel. Five radial threads, the anterior close to the median line of the disk, the posterior at the inner margin of the posterior area and slightly more isolated than the other 4; the middle radial less prominent than the others. Characters of the interior not known.

DIMENSIONS OF HOLOTYPE: Height, 2.0 millimeters; width, 3.5 millimeters.

HOLOTYPE (a left valve): U. S. Nat. Mus. 495017.

TYPE LOCALITY: U.S.G.S. sta. 13765 (E-18), 650 meters N. 70°E. from Rancho Viejo, China, Nuevo León. Upper part of Midway formation.

The name has a double significance for not only is it an adaptation of the place name but it is one of the earliest records of the group in the Gulf Tertiary.

*Cuspidaria vieja* seems closely related, to *Cuspidaria prima* (Aldrich), from Woods Bluff, Alabama. The Alabama species is higher relatively, with a shorter rostral snout, a rather coarser spiral sculp-



ture, and with vestiges, at least, of radials on the medial and anterior portions of the disk. Although the type of *Cuspidaria vieja* is unique, the radial sculpture has the appearance of an established pattern, while in the two specimens of *C. prima*, in addition to the few strong radials upon the posterior portion of the disk, there are obscure threads on the anteromedial portion and 2 fairly strong radials upon the rostrum.

*Cuspidaria vieja* has been certainly recovered only from the type locality. An allied or possibly identical species was collected at U.S.G.S. sta. 13488 (D-18).

#### Order TELEODESMACEA

#### Superfamily ASTARTACEA

#### Family ASTARTIDAE

#### *Incertae sedis*

(Plate 7, figure 15)

A generically indeterminate member of the Astartidae (U. S. Nat. Mus. 496000) was collected from the middle part of the Laredo formation at U.S.G.S. sta. 13642 (M-25), 2250 meters northwest of Rancho El Prieto, Presa Nueva, Santa Ana, China, Nuevo León; and at U.S.G.S. sta. 13645 (M-25), 1950 meters northwest of Rancho Barretosa, Barretosa, Santa Ana, San Fernando, Tamaulipas. The figured left valve is 12.5 millimeters high and 16.5 millimeters wide. Probably both the lunule and the escutcheon were defined. The concentric ribbing, fine and regular on the umbones but becoming abruptly strong and undulating on the disk, is bent upward anteriorly to the margin of the lunule and posteriorly to the margin of the escutcheon. The characters of the hinge and of the interior are not preserved.

The valve resembles most closely, in its surficial characters, the genus *Lirodiscus*. It is sculptured with 4 heavy adult ribs, 3 not quite so heavy, and probably at least a dozen finer ribs on the umbonal area.

#### Genus *Lirodiscus* Conrad

1869. *Lirodiscus* CONRAD, Am. Jour. Conchology, vol. 5, p. 46.

TYPE, BY MONOTYPY: *Astarte tellinoides* Conrad. Claiborne sand, Claiborne, Alabama.

The shell of *Lirodiscus* is transversely elongated, chalky in substance, and of moderate dimensions. The anterior end is bowed in front of the lunule and merges smoothly into the arcuate base. The posterior area of the type species is cut off by an impressed line initiated in front of the nepionic shell and reflected ventrally in a broad and shallow basal constriction. Both the lunule and the escutcheon are clearly defined by the angularity of the shell and the abrupt disappearance of the sculpture. The umbones are flattened, the tips acute, inclined inward and slightly forward. The surface sculpture of the beaks, as in the nepionic *Crassatellites*, is sharp, regular, and continuous from the lunule to the escutcheon, but away from the beaks the concentric ribbing becomes undulating, rapidly coarser, and more distantly spaced; toward the ventral margin it tends to be obsolete. All the adult ribs are nicked at the linear furrow that cuts off the posterior area, but back of the furrow they continue with unbroken strength to the margin of the escutcheon. The ligament is inset in a groove that extends along the dorsal margin from the very tip of the umbones. The dentition is similar to that of *Astarte*, but in the right valve the anterior cardinal is nothing more than a slight modification of the margin of the dental socket. A prominent deltoid subumbonal tooth is contained in the deep socket between a strong anterior and a less prominent posterior cardinal in the left valve. The lunular margin of the left valve is modified to function as a lateral and is received in the clasping socket of the right valve. The right posterior margin is similarly modified to be received in the clasping socket of the left posterior margin. The muscle impressions are remarkably large and distinct. The posterior adductor is buttressed along a line, corresponding in position to the linear furrow, that marks off the posterior area. The thickening around the anterior adductor, is produced backward to join the posterior buttress and to form a sort of yoke connecting the two adductors. The pallial line is obscure and moderately removed from the ventral margin. The inner edges from the extremity of the lunule to the extremity of the escutcheon are finely dentate.



*Lirodiscus* differs from *Astarte* in the relatively wider shell and in the development of the laterals and from *Crassatellites* in the absence of an internal ligament.

The reports of its existence in strata other than Eocene have not been verified. It is particularly characteristic of the middle Eocene of the Gulf Province.

*Lirodiscus?* n. sp.

Highly crystallized shells probably referable to *Lirodiscus*, but without determinable hinges, are fairly common in a brown clay of Jackson age heavily impregnated with crystalline calcite (U.S.G.S. sta. 13529, M-11). They are about 15 millimeters high and 20 millimeters wide. Like others of the group, they are compressed, with flattened umbones turned slightly forward. The adolescent shell, which seems rather more elongated transversely than the adult, is sculptured with 10 or 12 fairly strong, regular concentric cordlike ridges; the medial and later portions of the shell are rippled with half a dozen ridges, wider, more obtuse, and more distantly spaced than those on the adolescent. There is a slight kink and change in direction along the diagonal from the tips of the umbones to the posterior ventral margin, similar to that in *L. tellinoides* Conrad but less strongly marked. The species, which must be new, is smaller than *tellinoides*, and the sculpture, both upon the adolescent and the adult, is sharper, closer, and more regular.

Family CRASSATELLITIDAE

Genus *Crassatellites* Krüger

1823. *Crassatellites* KRÜGER, Geschichte der Urwelt, vol. 2, p. 466.

1799. *Crassatella* of authors, not *Crassatella* LAMARCK, Soc. histoire nat. Paris, Mém., p. 85, 1799.  
Sole species *Mastra cygnea* Chemnitz.

TYPE, BY MONOTYPY(?): *Crassatellites sinuatus* Krüger. Eocene of the Paris Basin.

Through the kindness of William J. Fox, the Assistant Librarian and Editor at the Academy of Natural Sciences in Philadelphia, I received the following copy of Krüger's original description:

"*Crassatellites sinuatus*. *Crassatelle bossue*.

"Mit sehr dicken Schaaalen, tiefen Muskeleindrücken und einzelnen Querreifen, welche auf der Oberfläche mit dem untern Rande der Schaaalen gleichlaufen. Häufig bei Grignon."

Shell slightly inequivalve, inequilateral, subquadrate or subtrigonal. Umbones anterior, usually prominent. Lunule and escutcheon distinctly depressed. Surface sculpture feeble, as a rule, concentric, commonly confined to the umbonal area. Ligament and resilium internal. Dentition vigorous; 3 cardinals in right valve, the posterior commonly effaced by the resilium; 2 cardinals in left. Anterior margin of right valve and posterior margin of left grooved to receive the beveled edge of the opposite valve. Muscle scars distinct, impressed. Pallial sinus simple. Ventral inner margins dentate.

The group was well established in the Gulf Province in the Upper Cretaceous, and there is no reason to doubt that the Tertiary representatives are autochthonous. The Recent forms are included in about 40 species, the majority tropical in habitat.

*Crassatellites antestriatus* (Gabb)

(Plate 6, figures 7, 10, 11, 14; Plate 7, figures 9, 10)

1860. *Crassatella antestriata* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 388, pl. 67, fig. 53.

1865. *Crassatella antestriata* Gabb. CONRAD, Am. Jour. Conchology, vol. 1, p. 10.

1887. Probably not *Crassatella antestriata* Gabb of ALDRICH, Cincinnati Soc. Nat. Hist., Jour., vol. 10, p. 81. Name included in a check list of fossils collected by Yoakum near Palestine, Texas.

1891. *Crassatella antestriata* Gabb. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, p. 403.

1895. *Crassatella antestriata* Gabb. HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 49, pl. 1, figs. 10, 10a.

1903. Probably not *Crassatella antestriata* Gabb of HAYES AND KENNEDY, U. S. Geol. Survey, Bull. 212, p. 53. Name included in a check list of fossils from near Burkeville, Newton County, Texas.

1919. *Crassatellites antestriatus* Gabb. HARRIS, Bull. Am. Paleontology, vol. 6, p. 98, pl. 34, figs. 3, 4.



**TYPE MATERIAL:** Holotype and three paratypes: Academy of Natural Sciences, Philadelphia 13259.

**TYPE LOCALITY:** Wheelock, Robertson County, Texas.

The specimen which Gabb figures is immature, but Harris in 1895 discussed and figured an adult from the Singley Collection from Elm Creek, Lee County, Texas, now deposited in the collections of the University of Texas at Austin.

Our Mexican specimens are in the form of double valves with an indurated filling, but they agree well with those from Texas. The shell is thick and ovate-trigonal; the umbones high, broadly inflated, and set a little in front of the median horizontal. The lunule is rather short, cordate, and deeply sunken; the escutcheon, linear lanceolate. The short anterior end is broadly, evenly rounded. An obtuse rostrum extending from the umbones to the posterior ventral margin is more clearly defined in the young forms than in the adults. Behind the rostrum, the shell is flattened and, at the lateral extremity, truncate from the steeply sloping dorsal margin to the extremity of the obtuse rostrum. The growth sculpture is decided even in the adolescent forms, but only the resting stages are continued across the disk. The prodissoconchs are small, flattened, quadrate shells rippled with about 6 concentric wavelets continuous from the lunule to the margin of the escutcheon. The characters of the interior are not accessible.

The figured adult is 45 millimeters high and 52 millimeters wide. The convexity of the double valves is 31 millimeters. The larger figured immature shell is 20 millimeters high and 25 millimeters wide. The smaller figured immature shell is 14 millimeters high, 17 millimeters wide, and the convexity of the double valves is 10 millimeters. The adult is registered as U. S. Nat. Mus. 497101, the larger adolescent shell as U. S. Nat. Mus. 494264, the smaller adolescent as U. S. Nat. Mus. 494952. The adult was collected at U.S.G.S. sta. 14063, the larger adolescent at U.S.G.S. sta. 13564, and the smaller adolescent at U.S.G.S. sta. 13454, all in the lower Laredo formation.

*Crassatellites antestriatus* (Gabb) is a less quadrate, more obliquely produced shell than *C. trapaquarus* Harris, and the inflation in the umbonal area is greater. *C. clarkensis* Dall is a lower, transversely elongate species, probably in the ancestral line of *C. protectus*. Throughout its distribution in the western Gulf, *C. antestriatus* is associated with faunas of lower or middle Cook Mountain and Laredo age and their time equivalents; *C. clarkensis* is characteristic of the upper Cook Mountain and Laredo, and *C. trapaquarus* of the Weches member of the Mount Selman formation. *Crassatellites texanus* (Heilprin) and *C. negreetensis* Harris, closely related species also characteristic of the Mount Selman, are set apart by the strong and regular concentric cording developed over the greater part of the shell exclusive of the posterior slope.

*Crassatellites tumidulus* (Whitfield) from the Tuscahoma of Alabama is similar but higher, more trigonal, and not so heavy. The holotype of Whitfield's species is reproduced (Pl. 6, figs. 4, 6).

**DISTRIBUTION:** Laredo formation: lower Laredo, U.S.G.S. sta. 13564 (H-12); U.S.G.S. sta. 13454 (H-15); U.S.G.S. sta. 13596 (H-15); U.S.G.S. sta. 14063 (J-19).

#### *Crassatellites texanus* (Heilprin)

1891. *Crassatella texana* HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, p. 406, pl. 11, fig. 6.

1895. *Crassatella texana* Heilprin. HARRIS, Acad. Nat. Sci. Philadelphia, Proc. for 1895, p. 50, pl. 2, fig. 1.

1919. *Crassatellites texanus* Heilprin. HARRIS, Bull. Am. Paleontology, vol. 6, p. 97, pl. 34, fig. 1.

"Shell irregularly rhomboidal; valves prominently angulated posteriorly, with the post-umbonal slope broad and slightly concave; umbones prominent, well incurved; hinge powerful; exterior surface ornamented with strong and closely set lines of growth, which traverse the entire shell, becoming, however, less prominent on the umbonal slope.

"Length of shell about an inch and a quarter, slightly exceeding the height. Smithville; McBee's School; near Alto; St. Augustine Co.

"This species is comparatively more elongated than *Crassatella antestriata*, of Gabb, which in some respects it closely resembles. The ornamentation, too, is carried completely across the shell, and is not restricted to the anterior moiety of the valves." Heilprin, 1891.

Heilprin's species is warped by a prerostal depression similar to that of *Crassatellites clarkensis* Dall. It differs from *C. clarkensis* and also from *C. antestriatus* and *C. trapaquarus* by the strong and, for the group, regular concentric liration developed over the entire umbonal portion and well on through the adolescent stage.



DISTRIBUTION: Mount Selman formation: Discocyclinid zone, near top of Mount Selman, ? U.S.G.S. sta. 13633 (L-24).

*Crassatellites clarkensis* Dall

(Plate 6, figures 5, 13, 15, 16)

1900. *Crassatellites clarkensis* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 5, pl. 36, figs. 20, 21.  
 1903. *Crassatellites clarkensis* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 6, p. 1470.  
 1919. *Crassatellites clarkensis* Dall. HARRIS, Bull. Am. Paleontology, vol. 6, p. 100, pl. 34, figs. 5, 6.

"Shell solid, elongated, moderately thick, inequilateral, the anterior end shorter, nearly equivalve; anterior end rounded, posterior end obliquely descending, pointed, and subrostrate, with a marked carina from the umbo to the posterior angle; lunule and escutcheon subequal, lanceolate, impressed; surface smooth except for incremental rugae and microscopic radial striation; nepionic shell small with about six sharp, low, concentric ridges, which cease abruptly in less than three millimeters from the apex; hinge well developed; scars of ligament and resilium of moderate size; third right (posterior) cardinal nearly intact and distinct; anterior and basal margins sharply, finely crenate, the subsurface layer of the shell weathering out with distinct ribs corresponding to the crenations. Lon. 42.5, alt. 26.5, diam. 19.0 mm.

"This resembles *C. protectus*, from which it is easily separable by its more pointed rostrum, sinuate below, and the very small space occupied by the nepionic sculpture, which in *C. protectus* extends over a radius on the disk of some eight or ten millimeters. The latter also has more conspicuous radial striation and coarser crenations." Dall, 1903.

The cotypes (U. S. Nat. Mus. 139086) are from U.S.G.S. sta. 2616, the Wautubbee Hills, Clarke County, Mississippi.

Harris has separated, under the varietal name *ludoviciana*, forms from St. Maurice and Enterprise, Mississippi, characterized by "rather fine and extensively displayed concentric marking." I have been unable to see in the Museum assemblages any variation other than individual.

*Crassatellites clarkensis* Dall differs from the other species in the Laredo formation by the transversely elongate, posteriorly flexuous outline. The Mexican specimens seem a little higher relatively than those from the eastern Gulf, but the suite of specimens is not sufficiently large to be sure that this is more than chance. The form is not abundant, but it seems to be associated in all its occurrences with faunas of upper Laredo age. None of the variations indicate time differences.

DIMENSIONS OF FIGURED SPECIMENS FROM MEXICO: Complete individual, height, 19.4 millimeters; width, 28.8 millimeters; convexity of double valves, 13.4 millimeters. Incomplete individual, height, 15 millimeters; width (estimated) 23 millimeters; convexity of double valves, 9.5 millimeters.

Complete individual, U. S. Nat. Mus. 496001. Incomplete individual, U. S. Nat. Mus. 496002.

LOCALITIES OF FIGURED SPECIMENS: Complete individual, U.S.G.S. sta. 13570; incomplete specimens, U.S.G.S. sta. 13569.

DISTRIBUTION: Laredo formation; middle Laredo, U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13553 (H-15); U.S.G.S. sta. 13634 (M-24).

Superfamily CARDITACEA

Family CARDITIDAE

Genus *Venericardia* Lamarck

1801. *Venericardia* LAMARCK, Système des animaux sans vertèbres, p. 123.

TYPE, BY SUBSEQUENT DESIGNATION (SCHMIDT, C. F., Versuch über die beste Einricht., etc., pp. 57, 176, Gotha, 1818): *Venericardia imbricata* Lamarck = *Venus imbricata* Gmelin. Eocene of the Paris Basin.

Shell nonbyssiferous, closed, rounded, trigonal, or cordate. Umbones anterior, prosogyrate. Lunule small but deep. Escutcheon narrow and elongate. Sculpture dominantly radial. Ligament external, opisthodetic, parivincular. Hinge dentition in the right valve consisting of three oblique cardinals; in the left valve of two; laterals of both valves absent or very feeble. Muscle impressions strongly defined. Pallial line entire. Inner margins crenate.



The important group of *Venericardia* (*Venericor*) *planicosta* Lamarck has already been considered<sup>1</sup> and will not be included in the present report.

Group of *Venericardia rotunda* Isaac Lea

(Plate 7, figures 17, 18)

*Venericardia rotunda* Lea in its present usage is a group rather than a specific name. Harris has indicated a number of divisions which may properly be made in it, and there are others, probably including our Mexican forms, which fall under no one of the names available. The Mexican specimens figured are individuals with the 2 valves tightly closed and filled with indurated matrix. One shell (fig. 17) has doubtless been unduly compressed and warped, and its original form modified. It is 14 millimeters high and a fraction of a millimeter broader; the present convexity is not quite 7 millimeters. The form is rudely quadrate, the ventral margin nearly horizontal, rounding shortly into the squarely truncate posterior lateral margin, but more smoothly into the broadly arcuate anterior end. The umbones are small, not very conspicuous, and acute at their tips which are slightly in advance of the middle. The lunule is very small and sunken. There is no escutcheon, and the posterior area is only vaguely indicated. There are 21 ribs in the right valve and 22 in the left, separated by U-shaped channels of a width approximately equal to the ribs on the medial and posterior portions of the shell but slightly wider anteriorly. The crests of the ribs are relatively broad and bluntly noded, the nodes best defined anteriorly. The ribbing crenulates the ventral margin. The interior is not accessible.

The second individual figured from the lower part of the Laredo formation at U.S.G.S. sta. 13568 (G-11) is 18 millimeters high, 19.5 millimeters wide, and 12.5 millimeters in convexity. The lateral and basal margins form a broad, slightly flattened arc, and there are only 19 noded ribs on each valve. The other characters are similar to those exhibited by the first individual also from the lower Laredo at U.S.G.S. sta. 13596 (H-15).

The smaller figured specimen is U. S. Nat. Mus. 496025, and the larger, U. S. Nat. Mus. 496265.

*Venericardia* sp. cf. *V. diversidentata* Meyer

Synonymy and description of *Venericardia diversidentata* Meyer:

- 1854. ?*Cardita tetrica* CONRAD, in WAILES' Rept. agriculture and geology of Mississippi, p. 289 (nomen nudum).
- 1866. ?*Venericardia jacksonensis* CONRAD, Smithsonian Misc. Coll., vol. 7, no. 200, p. 23 (nomen nudum).
- 1885. *Venericardia diversidentata* MEYER, Am. Jour. Sci., 3d ser., vol. 29, pp. 460, 467.
- 1885. "*Cardita tetrica*" Conrad. ALDRICH, Am. Jour. Sci., 3d ser., vol. 30, p. 307.
- 1896. *Venericardia jacksonensis* Conrad. VAUGHAN, U. S. Geol. Survey Bull. 142, p. 51.
- 1903. *Cardita tetrica* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 6, p. 1424.
- 1903. *Venericardia jacksonensis* Conrad. DALL, Wagner Free Inst. Sci., Trans., p. 1424.
- 1903. *Venericardia tetrica* Conrad. DALL, Wagner Free Inst. Sci., Trans., pp. 1427, 1428, 1429.
- 1903. *Venericardia diversidentata* Meyer. CASEY, Acad. Nat. Sci. Philadelphia, Proc., p. 264.
- 1919. *Venericardia tetrica* Conrad. HARRIS, Bull. Am. Paleontology, vol. 6, p. 85.

"In Jackson occurs *Venericardia diversidentata*, n. sp., similar to *Vener. rotunda* Lea but with a larger beak, and the tooth of the left valve horizontal, while in the Claiborne species it rises obliquely. Though one of the Claiborne species has also a large beak, the differences appear to me of such importance as to require a new specific name. The relation to *Vener. rotunda* is so obvious, that for instance in Hilgard's Geology of Mississippi it is enumerated under this name. In the young specimens of the Claiborne species the tooth has nearly, or perhaps entirely, the same form as in the Jackson species." Otto Meyer, 1885.

The Jackson species is not so large as the Claiborne form, but the inflation is greater, and the beaks fuller, higher, and more prominent. The lunule is very short but deep, especially in the right valve, and is defined by the contour and the abrupt cessation of the radial sculpture. The radials are strong, crested with serials of funicular lamellae separated by narrow, U-shaped interradians finely cross-hatched by the incrementals. The ligament is marginal, inset, and firmly mounted. The hinge plate is narrow, the dentition fairly strong, and similar in pattern to that of *V. rotunda*. The muscle scars are distinct and relatively large, the pallial line simple and rather distant from the

<sup>1</sup> Gardner, Julia, and Bowles, Edgar, *The Venericardia planicosta group in the Gulf Province*: U. S. Geol. Survey, Prof. Paper 189-F, pp. 143-215, 3 charts, text fig. 27, pls. 29-46, 1939.



margin. The margins from the lunule to the extremity of the ligament groove are crenate in harmony with the ribbing.

The group is represented at a number of localities in the Jackson of northeastern Mexico, notably at U.S.G.S. sta. 13637 (M-24), Presa Nueva, Santa Ana, China, Nuevo León, but the ribs are usually fewer in the Mexican forms than in the topotypes.

*Venericardia* sp. cf. *V. carsonensis* Dall

Synonymy and description of *Venericardia carsonensis* Dall:

Feb. 1903. ? *Venericardia vicksburgensis* CASEY, Acad. Nat. Sci. Philadelphia, Proc., p. 264.

Oct. 1903. *Venericardia carsonensis* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 6, p. 1427, pl. 56, fig. 9.

"Shell somewhat squarish, rounded, moderately inflated, thin, with about nineteen to twenty-one very narrow, elevated radial ribs, separated by much wider interspaces; sculpture imbricate-nodulous, the nodules in perfect specimens becoming irregularly spinose in the posterior third of the shell; the nodules are not so close to each other as in *V. tetrica* and *V. praecisa* as a rule, especially in the young; lunule small and impressed; the beaks are lower and the whole form less oblique than in *V. tetrica*; hinge normal, more delicate than in the other species mentioned. Length of a moderate-sized specimen 17.0, height 16.5, diameter 11.0 mm.

"While the spinosity of the posterior ribs is frequently worn away in adult individuals, it is quite noticeable in the younger perfect ones, and the relative sparseness of the ribs with their wide interspaces immediately distinguishes it from *V. tetrica* and other near allies. It reaches, judging by fragments, a length of twenty or twenty-two millimeters when full grown." Dall, 1903.

The specimen figured by Dall (U. S. Nat. Mus. 140693), here designated as the type, is from Carson's Creek, 5 to 6 miles southeast of Shubuta, Wayne County, Mississippi. It measures 13 millimeters in height with an almost equal width and a convexity of 5.2 millimeters.

A venericard with the strong sparse ribbing which characterizes *carsonensis* was recovered at a few localities in the Oligocene of northeastern Mexico. The material is not sufficiently good for positive identification.

DISTRIBUTION: Lower marine Oligocene sandstone: U.S.G.S. sta. 14056 (M-12); U.S.G.S. sta. 13531 (M-13); U.S.G.S. sta. 13537 (M-14).

*Venericardia* sp. cf. *V. carsonensis* Dall

A species, too imperfectly preserved to determine accurately, occurs in abundance at U.S.G.S. sta. 13993 (O-10), on the old road from Piedras to Loma Colorado, just north of the Tamaulipas-Nuevo León State line. It is included in a thin bed of partially silicified fossils underlain by green bentonitic clay, an ashy sandstone, and white volcanic ash resembling the Frio clay of south Texas. The overlying beds are tuffs, ashes, and porcelainite. The species may be close to *Venericardia carsonensis* Dall; the number of ribs is about the same, but they seem broader. The form is much distorted, and the hinge characters have not been preserved. In the Gulf region, *V. carsonensis* is confined in its known distribution to the Red Bluff clay at the base of the Oligocene. Its reappearance in large numbers appreciably later seems highly improbable, and the poorly preserved specimens in Camargo, Tamaulipas, probably represent an undescribed species.

Superfamily LUCINACEA

Family LUCINIDAE

Genus *Anodontia* Link

1807. *Anodontia* LINK, Beschreibung der Naturalien-Sammlung der Universität zu Rostock, vol. 3, p. 156.

TYPE, BY MONOTYPY: *Anodontia alba* Link. Recent in the West Indies.

*Anodontia* includes the relatively large, thin-shelled, highly inflated, edentulous lucinoids formerly referred to *Lucina*, s. s., and typified by *Venus edentula* Linnaeus. Commonly all but the interior molds of the double valves are lost in fossilization.

*Anodontia?* *subvexa* (Conrad)

1833. *Lucina subvexa* CONRAD, Fossil shells of the Tertiary formations of North America, p. 40.

1846. *Lucina subvexa* CONRAD, Am. Jour. Sci., 2d ser., vol. 1, p. 403, pl. 4, fig. 14.



1865. *Cyclas subvexa* CONRAD, Am. Jour. Conchology, vol. 1, p. 8.  
 1890. *Lucina (Loripes) subvexa* Conrad. DE GREGORIO, Annales Géologie Paléontologie, vol. 8, p. 206, pl. 29, fig. 14.  
 1903. *Lucina subvexa* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 6, p. 1352 (part).  
 1919. *Loripes subvexa* Conrad. HARRIS, Bull. Am. Paleontology, vol. 6, p. 119, pl. 39, fig. 1.

"Shell suborbicular; ventricose; with fine concentric and minute obscure radiating lines; posterior side with an obscure fold, anterior side elevated and subangulated above; hinge edentulous; anterior muscular impression not profoundly elongated; cavity very capacious; surface punctate." Conrad, 1833.

"Claiborne, Alabama.

"A rare species. I have but one valve, which is thin about the basal margin, thicker above, with a rough unequal radiato-punctate interior; the lunule small and impressed, and the hinge plate narrow and without teeth." Conrad, 1846.

Conrad's figure indicates an individual measuring about 25 millimeters from the anterior lateral to the posterior lateral margin.

The species has been recorded from Maryland to Louisiana and from the Bashi to the Jackson, and probably a group rather than a single species is involved.

The group of *Anodontia? subvexa* is represented in the lower or middle Jackson of Tamaulipas (U.S.G.S. sta. 13754, M-7) by a number of specimens with hinges firmly embedded in an indurated matrix but with fairly well preserved outer surfaces. They exhibit the characteristic ornamentation of the group—fine, sharp concentric lamination and, in the interlamellar spaces, a delicate radial hatching.

The best-preserved Mexican individual is about 15 millimeters high, and 17–18 millimeters wide. All representatives in our collections from the Jackson at Montgomery, Louisiana, are small, the greatest dimension only slightly exceeding 19 millimeters.

#### Genus *Phacoides* Blainville

1825. *Phacoides* BLAINVILLE, Manuel de malacologie et de Conchyliologie, vol. 1, p. 550.

TYPE, BY MONOTOPY: *Lucina jamaicensis* Lamarck = *Tellina pectinata* Gmelin. Recent in the West Indies.

Shell more or less lenticular; compressed, as a rule, or only slightly tumid. Umbones low, subcentral, erect or prosogyrate. Lunule commonly profound. Escutcheon obsolete. Anterior and posterior dorsal areas usually differentiated. Sculpture dominantly concentric. Ligament external, in many specimens deeply sunken. Normal dentition of right valve consisting of a simple anterior cardinal, a bifid posterior cardinal, and heavy anterior and posterior laterals; normal dentition of left valve consisting of a bifid anterior cardinal, a simple posterior cardinal, and heavy anterior and posterior lateral sockets; laterals in many specimens and the cardinals in some, obsolete. Muscle impressions strongly marked, the posterior oval, the anterior narrow, elongated parallel to the pallial line. Pallial line entire. Inner margins smooth or crenulated.

The genus is abundantly represented in the Tertiary, and related forms are present in the Mesozoic and possibly older faunas. More than 100 species are living; most of them are tropical, but a few live in the temperate seas.

#### *Phacoides quintamaia* Gardner, n. sp.

(Plate 7, figure 14)

Shell compressed to a thin lentil; the lateral margins obtusely truncate, the ventral margin broadly arcuate, the dorsal ascending gently to the small pointed subcentral beaks. Beaks turned forward. Anterior dorsal margin slightly scooped and less evenly declining than the posterior dorsal margin. Surface closely and evenly lirate concentrically with a few pronounced resting stages toward the base. Characters of interior not known.

DIMENSIONS OF HOLOTYPE: Height, 21.8 millimeters; width, 19.5 millimeters; convexity of double valves, 8 millimeters.

HOLOTYPE: U. S. Nat. Mus. 496028.

TYPE LOCALITY: U.S.G.S. sta. 13964 (H-6), Mier, Tamaulipas. Lower part of Yegua formation.



*Phacoides quintamaia* characterizes the single horizon in which it occurs and is, in our collections, restricted to it. While *P. quintamaia* has been recovered from the single locality in northeastern Mexico, on the Texas side of the Embayment it is abundant along the line of outcrop of the Cinco de Mayo sandstone.

*Phacoides?* sp.

Molds referable either to *Phacoides* or possibly to *Miltha*, which is characterized by 2 cardinals in each valve and no laterals in either, are not uncommon in the upper Oligocene limestone of the Mendez area at U.S.G.S. sta. 14033 (P-25). A fairly well preserved mold is about 30 millimeters high and a little less than 35 millimeters wide. Obscure remnants of a heavy, overlapping, concentric sculpture persist toward the ventral margins. No hinges are retained, and the anterior adductor scar cannot be traced. The thin outline, the compressed marginal area, and the low, sharp, narrow beaks indicate either *Phacoides* or *Miltha*, but nothing more definite can be said of them.

Subgenus *Parvilucina* Dall

1901. *Parvilucina* DALL, U. S. Nat. Mus., Proc., vol. 23, p. 806.

1903. *Parvilucina* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 6, p. 1362.

TYPE, BY ORIGINAL DESIGNATION: *Lucina tenuisculpta* Carpenter. Recent on the west coast from Bering Sea to the Coronado Islands.

"Shell small, plump, often inequilateral; sculpture more or less reticulate but not muricate, teeth small, but all usually present." Dall, 1901.

*Phacoides (Parvilucina)* sp.

In the discocyclinid zone near the top of the Mount Selman formation, at U.S.G.S. sta. 13628 (L-24), a small, subglobose *Phacoides (Parvilucina)* sp. is rather commonly preserved as molds with bits of adherent shell. The valves are more inflated than those of *P. smithi* (Meyer), described from Claiborne, Alabama, and the few sculpture fragments indicate a faint radial striation but no strong concentric pattern such as that developed on *P. smithi*.

In the middle Laredo of the same general area (U.S.G.S. sta. 13639, M-25), fragments of another small lucinoid have been recovered. The characteristic feature of the second species is the strong and distant concentric sculpture, especially on the umbones.

The subgenus is also represented in the brownish-yellow sandstone of the middle part of the Laredo formation outcropping at U.S.G.S. sta. 13634 (M-24). Probably more than one, possibly three, species are present, one of them exhibiting a delicate reticulate sculpture.

Genus *Divaricella* Von Martens

1880. *Divaricella* VON MARTENS, Beiträge zur Meeresfauna der Insel Mauritius und der Seychellen, Mollusken, p. 321.

TYPE, BY MONOTYPY: *Lucina (Divaricella) angulifera* Von Martens = *Lucina ornata* Reeve. Recent off Mauritius.

Shell of moderate dimensions, subcircular, inflated. Umbones low, nearly central. Lunule small and deeply impressed, larger in the right valve. Dorsal areas rarely defined. Sculpture a deep, oblique grooving, divergent at a rather low angle along a line extending from the umbones to the ventral margin. Hinge plate narrow; 2 cardinals in each valve, the outer cardinals laminar, the inner relatively heavy; anterior and usually posterior laterals present in both valves, those of the left valve double. Anterior adductor scar lucinoid, paralleling the simple pallial line. Inner margin finely crenate.

When present at all, the individuals are commonly numerous, but it is a genus by no means universally distributed. In the eastern Americas, there is no record of the genus below the Oligocene.

*Divaricella* sp.

Locked double valves retaining the characteristic diagonal sculpture of *Divaricella* are among the partially silicified fossils from the upper middle Oligocene sandstone at U.S.G.S. sta. 13539 (N-17)



near Rancho Miralejas, Carlos Cantú, Nuevo León. *Divaricella subrigaultiana* (Meyer), 1886, the only other species described from the Oligocene, is more coarsely sculptured than either of the two specimens, and its valves are moderately compressed. Though too poorly preserved to name, the specimens retain the diagnostic characters of the genus sufficiently well to establish *Divaricella* in the Oligocene of northeastern Mexico.

A second species, indicated by molds with a similar sculpture but more inflated valves, occurs rather commonly at U.S.G.S. sta. 14144 (P-22).

### *Divaricella* sp.

Internal molds of double valves of *Divaricella*, a few of them with fragments of shell adherent, are common in the sandy yellow limestone of the high Oligocene at U.S.G.S. sta. 13579 (P-25), 5 kilometers N. 21°W. of Mendez. They are smaller than the Floridian species *Divaricella chipolana* Dall and average possibly 15 millimeters in height and 17 in width, but no other character is retained by which they can be separated from the lower Miocene form. The Vicksburg species, *Divaricella subrigaultiana* (Meyer), apparently an adult, is very small, only about 7 millimeters in height and width, but the grooving is decidedly coarser.

### Family DIPLODONTIDAE

#### Genus *Diplodonta* Bronn

1831. *Diplodonta* BRONN, Italiens Tertiär-Gebilde, p. ix.

TYPE, BY SUBSEQUENT DESIGNATION (HERRMANNSEN, Indicis generum malacozoorum, vol. 1, p. 392, 1847): *Venus lupina* Brocchi. Miocene and Pliocene of the Piedmont of Italy.

Shell equivalve, not gaping, subcircular, the beaks subcentral and not prominent. Lunule and escutcheon not defined. External surface smooth or incrementally sculptured. Ligament chiefly external, supported on marginal nymphs. Hinge of right valve armed with a simple anterior and a bifid posterior cardinal; hinge of left valve, with a bifid anterior and a simple posterior cardinal so that in the closed valves the two outer cardinals are simple, the two inner cardinals bifid. Laterals absent. Adductor impressions oval, the anterior longer and narrower than the posterior. Pallial line entire; inner margins of valves smooth.

The genus is first noted in the Cretaceous; from that time on, it has constituted one of the less conspicuous elements in the bivalve faunas. The 40-odd Recent species have a wide distribution in the warmer waters of the globe.

#### Subgenus *Sphaerella* Conrad

1838. *Sphaerella* CONRAD, Fossils of the Tertiary formations of the United States, p. 17, Philadelphia.

TYPE, BY MONOTYPY: *Sphaerella subvexa* Conrad. Yorktown formation of Virginia.

"Shell equivalve, spheroidal; cardinal teeth three in the left valve, the posterior tooth large, compressed and transverse, or parallel with the cardinal line; muscular impressions large, scarcely impressed; marginal pallial impression entire." Conrad, 1838.

Superficially *Sphaerella* may readily be separated from *Diplodonta* by the thin, highly inflated shell and conspicuous umbones. The most significant difference, however, is in the hinge. Behind the short, simple anterior cardinal of the right valve is a compound tooth which, in a much modified form, represents the bifid cardinal of *Diplodonta* s.s. The anterior prong is not greatly changed, but the posterior is much thickened and obliquely elongated parallel to the dorsal margin, and its posterior surface is elevated into a sharp lamina. The lamina, however, is decidedly more elevated in the subgenotype than in the Recent *Sphaerella*. The anterior cardinal of the left valve is thin but medially cleft both upon the dorsal and the ventral surface. The left posterior cardinal is pushed backward to make space for the modified right posterior cardinal and is elongated in adjustment to the elongated prong of the right bifid tooth.

The subgenus includes relatively few species, ranging from the Cretaceous to the Recent, and all of them from eastern North American waters.



*Diplodonta (Sphaerella) anteproducta* Harris

(Plate 7, figures 2, 5)

1895. *Sphaerella? anteproducta* HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 50, pl. 2, fig. 4.  
 1896. *Sphaerella(?) anteproducta* Harris. VAUGHAN, U. S. Geol. Survey, Bull. 142, p. 48.  
 1900. *Diplodonta turgida* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 5, p. 1181 (part).  
 Not *Loripes? turgida* CONRAD, 1848. Vicksburg species.  
 1919. *Sphaerella anteproducta* HARRIS, Bull. Am. Paleontology, vol. 6, p. 124, pl. 40, figs. 6-8.

"Size and general form as indicated by the figure; anterior somewhat produced, laterally compressed; posterior dorsal margin likewise somewhat compressed; ventricose.

"The species is much more ventricose than *inflata* Lea, from Claiborne, and scarcely as much so as *turgida* Con., from the Vicksburg beds. The umbones are intermediate in size between *inflata* and *turgidula* [*turgida*], the size greater than either." Harris, 1895.

TYPE: Singley Collection (Austin, Texas?).

TYPE LOCALITY: Cedar Creek, southeast corner of Wheelock League near the Old San Antonio road following the Brazos County line, Texas? Cook Mountain formation.

Harris' drawings of the hinge, published in his report of 1919, are excellent. He reports the species from the upper part of the lower Claiborne of Mississippi, Louisiana, and Texas. The specimen figured to accompany his original description in 1895 cannot be the same as that which he figured in 1919 under the caption "type specimen, Singley Coll., Tex." The illustration of 1919 is much closer to those from our Mexican collections. The Mexican specimens are in the form of double valves about the size and something of the shape of marbles. The beaks are inflated and central, with incurved, prosogyrate tips. In front of the beaks, the shell is constricted, a little produced, and broadly rounded. The posterior dorsal margin slopes rather gently; the lateral margin merges smoothly into the upcurved base. There is no lunule nor escutcheon and only a slight flattening of the posterior portion of the shell. Bits of thin worn shell adhere to some of the molds. Neither the characters of the hinge nor of the interior are evident on any specimen.

Dimensions of figured double valves: Height, 15 millimeters; width, 16 millimeters; convexity of double valves, 12.7 millimeters. The specimen is U. S. Nat. Mus. 496266 from U.S.G.S. sta. 13547 (I-14).

DISTRIBUTION: Laredo formation: middle Laredo, U.S.G.S. sta. 13567 (H-11), ?U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13547 (I-14).

## Superfamily LEPTONACEA

## Family KELLIELLIDAE

Genus *Lutetia* Deshayes

1860. *Lutetia* DESHAYES, Desc. Animaux sans vertèbres, vol. 1, p. 787.  
 1860. *Lutetia* DESHAYES, Desc. Animaux sans vertèbres, Atlas 1, pl. 16 bis, figs. 34-36.  
 1900. *Lutetia* Deshayes. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 5, p. 1166.  
 1920. *Lutetia* Deshayes. HARRIS, Palaeontographica Americana, vol. 1, no. 2, pp. 107-112, [3-8].

TYPE, BY SUBSEQUENT DESIGNATION (Cossmann, Soc. royale Zool. Malacolog. Belgique Annales, vol. 49, app. 5, p. 107, 1913): *Lutetia parisiensis* Deshayes (Eocene of the Paris Basin).

*Lutetia* which has been fairly recently monographed by Harris includes a small group of mid-Eocene leptonids. The shells are minute lentils, moderately heavy, relatively, and sculptured only with more or less obscure incrementals. The beaks are nearly central, obtusely pointed, not conspicuous, turned forward. There is a large lunule outlined by an incised line, but no escutcheon. The ligament is submarginal and attached to a short nymph elongated parallel to the posterior dorsal margin. There is no resilium. In the right valve, a short oblique lamina is directed backward from beneath the umbones and united at its anterior end with an even more delicate lamina directed forward parallel to the dorsal margin. A third slightly less delicate lamina springs from the inner surface of the dorsal margin below the anterior lamina and terminates in a minute denticle directly beneath the tips of the umbones. In the left valve, the  $\Lambda$ -shaped tooth developed on the ventral margin of the hinge plate is in the closed shell, bent around the ventral lamina of the right valve; the short but relatively heavy posterior lamina takes its place between the right posterior lamina



and the dorsal margin. The interior of the shell is highly polished, and the rather large muscle scars are not easily discernible. The pallial line is simple and removed from the ventral margin.

The distribution of *Lutetia* is characteristically middle Eocene. The genus has been reported from the later Tertiary, but both the Miocene and the Oligocene records have been questioned. In the Gulf, the known distribution is restricted to the Claiborne. The related Jackson forms, like the lower Miocene, are referable to *Alveinus*.

*Lutetia texana* Harris

1920. *Lutetia texana* HARRIS, Palaeontographica Americana, vol. 1, p. 111, pl. 17, figs. 7, 8.

"General appearance like that of the type of the genus, *parisensis* [*parisiensis*], though perhaps a little more elliptical in outline; size ranging from 1 to 2 mm. in greatest diameter; surface rather smooth and shining though showing traces of concentric undulations; lunular area large and occasionally well defined by a radiating, impressed line that sometimes produces a slight notch on the anterior margin of the shell; interior smooth and shining with but faint traces of muscular scars; margin of the *right valve* keeled as it were in the form of a faint anterior lateral over the lunular area, changing below into a grooved-margin appearance; ligamental margin deeply channelled, passing below into the regularly, more faintly grooved margin mentioned above; cardinal platform comparatively narrow, showing below and anteriorly a rather strong tooth turned beak-wards and separated by a deep pit from a small, short, thin tooth nearer the lunule margin just beneath the beak; connected more or less intimately with the latter and extending obliquely backwards is the strongest tooth of the hinge structure; just behind this tooth a depressed area marks the pit for the tooth in the opposite valve, passing upwards and backwards into the ill defined ligamental area; *left valve* with anterior, lunular margin showing a groove; ligamental margin keeled, forming as it were a long posterior lateral tooth; remaining margin appearing more or less channelled; hinge platform rather narrow, showing anteriorly and beneath the umbo the usual hammer-shaped tooth of this genus with 'head' immediately beneath the umbo and with pits above and below the 'handle' for the reception of the teeth in the opposite valve; posteriorly a deep pit for the reception of the large, oblique tooth of the opposite valve, followed posteriorly by a ridge-like tooth which forms the lower margin of the nymph.

"The appearance and dentition of this species is like that of typical *Lutetia*. Though smaller, it might perhaps be referred to a subspecies of *umbonata* Desh. The strong sub-umbonal tooth in the right valve with the corresponding deep pit in the left—both taking the exact place of the resilium in *Alveinus*—serves to distinguish this species at once from any other species heretofore described from our American Tertiaries.

"*Horizon*.—St. Maurice, middle Eocene. [Weches member of the Mount Selman formation.]

"*Locality*.—San Augustine road, 5.5 miles east of Nacogdoches Hill on east side of Tuscon Creek, Texas,—Olsson.

"Type specimens figured.—Pal. Mus. Cornell Univ." Harris, 1920.

The figures of the two cotypes indicate a considerable range in outline from subcircular to ovate. In Texas, the genus is widespread in the lower Claiborne. There seems to be a tendency toward a stronger incremental sculpture and a heavier hinge on the later forms. When properly discriminated the Cook Mountain shells present constant differences of probable taxonomic value.

In Mexico the *Lutetias* are locally abundant in a soft sandstone matrix. They seem to be true *texana* and occur at a horizon, probably synchronous with the Weches, the upper member of the Mount Selman formation.

DISTRIBUTION: Mount Selman formation: ?U.S.G.S. sta. 13627 (L-24); ?U.S.G.S. sta. 13628 (L-24).

Superfamily CARDIACEA

Family CARDIIDAE

Genus *Cardium* Linnaeus

1758. *Cardium* LINNAEUS, Systema naturae, 10th ed., p. 678.

1799. *Cardium* LAMARCK, Prodrome d'une nouvelle classification des coquilles: Soc. hist. nat., Paris, Mém., p. 86.

TYPE, BY SUBSEQUENT DESIGNATION (SCHMIDT, C. F., Versuch über die beste Einricht., etc., pp. 53, 176, Gotha, 1818): *Cardium costatum* Linnaeus. Recent in the Indo-Pacific.

The type of the genus is a thin, gaping, highly inflated, transversely elongate shell, with narrow elevated radials persistent to the margin and interlocking at the margin with the radials of the op-



posite valve. The cardinals of the right valve are 2 prominent cusps united at the base and received between the anterior and posterior cardinals of the left valve, one beneath the other. Both the anterior and the posterior laterals are strongly developed in both valves.

*Cardium s. s.* is not recorded in the fossil state.

#### Genus *Cerastoderma* Mörch

1853. *Cerastoderma* MÖRCH, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra et Gadea Comes de Yoldi, fasc. 2, p. 34.

1930. *Cerastoderma* (Poli) Mörch. STEWART, Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, p. 259.

TYPE, BY SUBSEQUENT DESIGNATION (VON MARTENS, Zool. Rec. for 1869, vol. 6, p. 586, 1870): *Cardium edule* Linnaeus. Recent along the European shores from the North Atlantic to the Mediterranean.

Valves closed, rotund, transversely or obliquely ovate, cordate in outline. Anterior and posterior areas inconspicuous or not defined. Radial costae numerous, elevated, smooth or granulated or imbricated. Intercostal areas simple. Left cardinal cusp anterior when interlocked.

#### *Cerastoderma carlotae* Gardner, n. sp.

(Plate 8, figures 1-3)

Shell rather small for the group; beaks prominent, highly inflated above the short dorsal margins; anterior margin rounding broadly into the straight base line; posterior margin obliquely truncate. Tips of umbones turned inward and slightly forward. Posterior area flattened and set off by an umbonal ridge which becomes less pronounced toward the base. Sculpture imperfectly preserved. About 25 ribs on anterior and medial portions of the shell and an additional 8 or 9 on the posterior area; flattened and separated by little more than linear interspaces; scattered traces of tubercles on the crests of the medial and posterior ribs, their exact original form and distribution not known. Characters of hinge and interior imperfectly known. Remnants still retained in the cotypes of the clasping cardinals, of a short anterior lateral in the left valve, and of a clasping lateral in the right; traces retained on other individuals of a short posterior lateral in the left valve and of a corresponding clasping lateral in the right.

DIMENSIONS: Right valve (cotype), height, 26.5 millimeters; width, 25.5 millimeters; convexity 12.7 millimeters. Left valve (cotype), height, 26.8 millimeters; width, 25.8 millimeters; convexity, 12.8 millimeters.

TYPE MATERIAL: Two cotypes, a right valve, and a left valve, of two individuals, U. S. Nat. Mus. 494966.

TYPE LOCALITY: U.S.G.S. sta. 13460 (B-7), Cuevas Ridge, 4 kilometers northwest of Juarez, Cerralvo, Nuevo León. Lower part of Midway formation.

*Cerastoderma carlotae* is another of the rather surprisingly large number of species in the Midway faunas of northeastern Mexico with little or no representation north of the Rio Grande. Possibly temperature conditions differed sufficiently to account for the absence of the species on the Texas side. The relationship to *Cerastoderma tuomeyi* (Aldrich) (pl. 8, figs. 4, 7-9), a less angular species from the lower Wilcox, is sufficiently close to suggest a common ancestral stock.

In an imperfect state of preservation, *Cerastoderma carlotae* may be similar to *Venericardias* of the *V. smithii* type. It is smaller than the usual *smithii*, the beaks have a less pronounced forward twist and are higher, the posterior area is more abruptly flattened, and the radials more crowded.

DISTRIBUTION: Midway formation: lower Midway, U.S.G.S. sta. 13459 (B-6); U.S.G.S. sta. 13460 (B-7); U.S.G.S. sta. 13471 (B-9); U.S.G.S. sta. 13470 (B-9); U.S.G.S. sta. 13464 (B-9); U.S. G.S. sta. 13463 (B-9).

#### *Cerastoderma* sp.

(Plate 8, figures 5, 6)

*Cerastoderma* is represented in the lower Eocene of northeastern Mexico by two or three imperfectly preserved species possibly related to *Cerastoderma tuomeyi* (Aldrich), (pl. 8, figs. 4, 7-9) from the Nanafalia of Alabama. One of them is known only from rather abundant molds recovered from an



impure limestone, probably from a horizon corresponding to the upper Kincaid of south Texas. The limestone is scarp forming, and the collection was made at U.S.G.S. sta. 13459 (B-6), 5.5 kilometers south-southeast of Agualeguas, Nuevo León. The molds are highly inflated and bear impressions of 18 square-cut, rather high ribs on the medial portion. There are at least 8 posterior ribs and probably 1 or 2 more at both the anterior and posterior dorsal extremities, either obscured by the matrix or not preserved. The shell is recrystallized calcite and breaks readily. The shell substance is preserved in a few individuals, and in one, 4 or 5 medial ribs show a slight longitudinal bifurcation which may indicate a row of pustules or spines. The posterior rostrum is much more clearly defined than in *Cerastoderma tuomeyi* (Aldrich). The rib count runs higher by 8 or 10 in the Alabama species, and the inflation is higher and more uniform. The figured specimen is U. S. Nat. Mus. 494976.

Molds from the middle part of the Indio formation, U.S.G.S. sta. 13690 (E-5), 75 meters north of the brecha crossing in Arroyo Santo Domingo, Nuevo León, though seemingly more inflated, are similar in outline and rib count to the Agualeguas species, but the horizon is higher, and well-preserved material would probably show specific differences. Molds from the lower part of the Indio formation (U.S.G.S. sta. 13461, D-4) are larger than any from the collections in Agualeguas or Arroyo Santo Domingo but are similar in general form and ornamentation.

#### Subgenus *Dinocardium* Dall

1900. *Dinocardium* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 5, p. 1074.

1901. *Dinocardium* DALL, U. S. Nat. Mus., Proc., vol. 23, p. 384.

1930. *Dinocardium* Dall. STEWART, Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, p. 261.

TYPE, BY ORIGINAL DESIGNATION: *Cardium robustum* Solander = *Cardium magnum* Born, 1780 not Linnaeus, 1758. Recent from Virginia to Florida and the Gulf of Mexico.

"Shell with more or less coloration, periostracum thin, polished, and inconspicuous; ribs with anteriorly, arcuate, hardly raised imbrications; mesially flattened and nearly smooth; posteriorly depressed and polished. Type *Cardium magnum* Born = *C. ventricosum* Bruguière.

"This group is notable for its elegant sculpture, from which spines, pustules and elevated scales are absent. It replaces in warmer waters of America the *Cerastodermas* of the North, and goes back in geological time, with its characters well marked, as far as the Oligocene." Dall, 1900.

#### *Cerastoderma (Dinocardium) bakeri* Gardner, n. sp.

(Plate 4, figures 11, 14)

Shell small for the group, the width slightly exceeding the height, the convexity strong and even along both the vertical and horizontal axes. Anterior lateral and basal margins broadly and feebly curved, merging into one another. Posterior lateral margin obliquely truncate and the posterior area defined by a pronounced flattening of the valve and the absence of the radial sculpture. Radials numbering between 25 and 30, the anterior portion of the valve so firmly embedded in the matrix that the sculptural characters are obscured. Ribs closely and evenly spaced, simple, broadly rounded, or somewhat flattened on their summits, obsolete on the posterior slope and possibly on the anterior. Concentric lamination even and possibly fairly strong in an unweathered specimen. Ligament groove short and deep. Subumbonal posterior cardinal moderately strong, a rather small dental pit in front of it, and, springing from the inner surface of the anterior dorsal margin, a very small tubercle which represents the anterior cardinal. Lateral sockets deep, the raised inner margins short and strong, fairly close to the cardinals. Adductor scars set high up near the ventral extremities of the laterals, anterior scar unusually deep. Pallial line not discernible. Inner ventral and anterior margins strongly and evenly crenate, the ribs and channels of approximately equal width and contour.

DIMENSIONS OF HOLOTYPE: Height, 14.5 millimeters; width, 15 millimeters; convexity, 6 millimeters.

HOLOTYPE, A RIGHT VALVE: U. S. Nat. Mus. 497159.

TYPE LOCALITY: U.S.G.S. sta. 13510 (M-11). Lower marine Oligocene sandstone.

The outline and sculpture pattern of *C. bakeri* suggest a miniature *C. chipolanum*. Like *bakeri*, it is known by a flattened posterior slope on which the radial sculpture is obsolete. The species is named in honor of William A. Baker, Jr., the chief geologist of the Company to which we owe our collections. The distribution seems to be restricted to the lower marine Oligocene.



DISTRIBUTION: Lower marine Oligocene sandstone: U.S.G.S. sta. 13510 (M-11); U.S.G.S. sta. 13511 (M-11); U.S.G.S. sta. 13522 (M-11); U.S.G.S. sta. 14056 (M-12); U.S.G.S. sta. 13537 (M-14).

*Cerastoderma (Dinocardium)?* sp.

Fragments of a species similar in general sculpture pattern to *Cerastoderma (Dinocardium) bakeri* Gardner but larger by 50 per cent are associated with *bakeri* in the lower Oligocene sandstone at U.S.G.S. sta. 13537 (M-14). They probably represent a form closely related but distinct taxonomically, for *C. bakeri* in its observed occurrence, shows only a slight range of variation in height and width. Another species sculptured by even more numerous and more crowded ribs is indicated by fragmentary material from U.S.G.S. sta. 13533 (O-19), above the lower marine Oligocene sandstone at the northwest corner of the main square at Rancho Laguna de los Indios, China, Nuevo León. "*Cardium*" *eversum* Conrad, described from Vicksburg, Mississippi, is similarly sculptured upon the disk. The type, in the collection of the Academy of Natural Sciences of Philadelphia, displays more than 60 ribs.

*Cerastoderma (Dinocardium) cabezai* Gardner, n. sp.

(Plate 4, figures 7, 8, 10)

Shell of only moderate dimensions for the group, rather thin, trigono-cordate. Disk evenly inflated. Beaks full and rather broad, incurved and orthogyrate. Posterior area flattened and sharply set off from the medial portion. Anterior margin broadly rounded and rounding obliquely into the base. False lunule and escutcheon fairly distinct. Surface sculpture of closely spaced quadrate ribs on the medial and anteromedial portions of the shell, 36 on the right valve of the cotype, 35 on the left cotype of another individual, the 5 or 6 anterior ribs lower and obliquely inclined away from the dorsal margin. Posterior area scored with 6 to 8 obscure and not very regular grooves. Interspaces on the anterior and medial portions broadly U-shaped; imbricated by the growth lines. External ligament groove deep, the nymph extending about half the length of the dorsal margin. Anterior dorsal margin flaring up and adnate to the umbones. Two unequal cardinals in each valve, the two strong cardinals in the clasped valves ventral and intermediate between the smaller anterior and posterior cardinals. Anterior and posterior double laterals in each valve not conspicuously close to the tips of the umbones. Muscle scars fairly distinct, the pallial line obscure. The reflected ribs are visible on the inner surface of the ventral and anterior margins.

DIMENSIONS: Height of right cotype, 42 millimeters; of left cotype, 36 millimeters; width of right cotype, 39 millimeters; of left cotype, 35 millimeters; convexity of right cotype, 15 millimeters; of left cotype, 13 millimeters.

TYPE MATERIAL: Two cotypes, a right and a left valve of different individuals, U. S. Nat. Mus. 495176.

TYPE LOCALITY: U.S.G.S. sta. 10603, gully south of the road and east of the bridge over White's Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Florida. Shoal River formation.

*Cerastoderma (Dinocardium) cabezai* is close to *C. (D.) taphrium* Dall, and a few specimens were earlier included under *taphrium* by the writer (Gardner, Julia, U. S. Geol. Survey, Prof. Paper 142-C, p. 139, 1926). Later collections indicate that the relatively high and narrow valves with rib counts averaging 35 and 36 instead of 32 and 33 are characteristic of a slightly higher horizon and should be separated taxonomically. It is significant that the common form in the Guajalote beds is of this later type.

The species is preserved in the form of molds only, but in the outline of the shell and the number and spacing of the ribs the Mexican and Floridian species seem identical.

DISTRIBUTION: Guajalote formation: ?U.S.G.S. sta. 13574 (U-23); ?U.S.G.S. sta. 13584 (V-29); ?U.S.G.S. sta. 13585 (V-29); ?U.S.G.S. sta. 13455 (W-29); ?U.S.G.S. sta. 13587 (W-30); ?U.S.G.S. sta. 13588 (W-30).

*Cerastoderma (Dinocardium)* sp.

A single valve more inflated and more closely ribbed than *Cerastoderma cabezai* is not separable from specimens from Gatun identified as *Cerastoderma dominicense* (Gabb) = *gatumense* (Toula).



The valve in question was collected at U.S.G.S. sta. 13586 (V-29), 11,500 meters N.30° W. of San Fernando, Tamaulipas, in the Guajalote formation.

Genus *Trachycardium* Mörch

1853. *Trachycardium* MÖRCH, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra et Gadea Comes de Yoldi, fasc. 2, p. 34.

TYPE, BY SUBSEQUENT DESIGNATION (Von Martens, Zoological Record for 1869, vol. 6, p. 586, 1870); *Cardium isocardia* Linnaeus. Recent on the east coast from Hatteras to Trinidad; fossil in the later Tertiary and Pleistocene.

*Trachycardium* is relatively high, inflated, and of moderate dimensions. The posterior cardinal of the right valve and the anterior cardinal of the left are heavy and when interlocked are flanked by the feeble anterior cardinal of the right valve and the feeble posterior cardinal of the left. The clasping laterals are strong and moderately distant from the cardinals. The characteristic sculpture includes numerous evenly spaced ribs decorated with asymmetrically arcuate lamellae concave on their ventral surfaces, and set like imbricating scales along the posterior margins of the ribs.

*Trachycardium* in the sense in which it is used by Stewart, 1930, is restricted to warm-temperate and tropical American waters, but, in the larger sense, the distribution of the genus ranges through the warmer waters of the globe.

*Trachycardium* sp.

(Plate 11, figure 2)

The right valve (U. S. Nat. Mus. 496456) of a species of *Trachycardium*, apparently undescribed, was recovered from the upper Oligocene at U.S.G.S. sta. 13581 (P-25), from the sandy limestone outcropping 2600 meters S. 50° E. from Rancho Gigante, Mendez, Tamaulipas. The shell is rather thin, strongly but evenly inflated, 15 millimeters high, 14 millimeters wide, and 6 millimeters in convexity. The outline of the interior is rudely quadrate, the anterior and basal margins broadly rounded, the posterior almost vertically truncate, the dorsal margins nearly horizontal. The full subcentral umbones are turned slightly forward at the tips. The details of the sculpture pattern are lost, but 23 squarish ribs are evenly spaced upon the disk. Posteriorly the ribs abruptly disappear, but anteriorly they gradually evanesce. The incremental sculpture overrides the radial, and toward the margins there are a few crowded resting stages. The posterior cardinal is a strong upcurved hook at the posterior margin of the socket, while the anterior cardinal is very short and is almost at right angles to the posterior along the dorsal margin of the pit. The clasping laterals, especially the anterior, are strong and rather distant from the subumbonal cardinals. There is nothing in the Vicksburg fauna of Mississippi that very closely approaches the species represented by this single valve.

Genus *Trigoniocardia* Dall

1900. *Trigoniocardia* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 5, p. 1075.  
1930. *Trigoniocardia* Dall. STEWART, Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, p. 267.

TYPE, BY ORIGINAL DESIGNATION: *Cardium graniferum* Broderip and Sowerby. Recent from the Gulf of California to Panama.

"Shell small, few ribbed, medial ribs very strong; posterior end subtruncate with smaller closer ribs; channels strongly concentrically sculptured; shell colorless, periostracum smooth." Dall, 1900.

"The genus *Fragum* is not known from American waters and apparently never reached the New World. *Trigoniocardia* Dall (1900, p. 1075) which was described as a section of the subgenus *Fragum* has a different hinge and is to be treated as a distinct genus. These two genera were considered related because of the prominent posterior umbonal slope present on both, but *Fragum* has the posterior laterals crowded toward the cardinals while *Trigoniocardia* has the anterior laterals crowded against the cardinals. . . . The hinge of *Trigoniocardia* seems more closely related to that of *Trachycardium* than to that of *Fragum*. The hinge plate is wider than on *Fragum* so that the cardinals do



not protrude ventrally where they join the hinge, while the anterior right and posterior left cardinals are less developed than in *Fragum*. This wide hinge plate and unequal cardinals are characteristic of *Trachycardium* s.s. and suggest that *Trigoniocardia* is related to it." Stewart, 1930.

*Trigoniocardia* has not been recognized in strata older than the Oligocene.

#### *Trigoniocardia* sp.

A species, abundant in the upper Oligocene at U.S.G.S. sta. 13579 (P-25), 5 kilometers north of Mendez, Tamaulipas, resembles the uncommonly well characterized *Trigoniocardia alicula* Dall from the Chipola marl of Florida.

*Trigoniocardia alicula* may be known by the conspicuously trigonal outline, the prominent costal that defines the posterior keel, the tendency toward a broad and more or less strongly marked depression of the medial part of the posterior area and, in the young, by the feeble constriction in front of the keel.

The specimens from Ballast Point, Florida, are similar but relatively higher and narrower dorsally, with no trace of a constriction either behind or in front of the posterior keel and with fewer and lower costals. In the few specimens from the upper Oligocene of the eastern Gulf there are none in which the keel is so sharply pinched as it is in the lower Miocene species. In the Mexican individuals, the characteristic outline of the Alum Bluff and Tampa forms is evident. Fragments of shell still adhere to some of the Mexican individuals and indicate a slightly higher rib count than in *T. alicula*, but that is the only distinguishing character between the Mexican and Floridian forms.

In the abundance of the individuals, also, the Mexican occurrence recalls that of the lower bed at Alum Bluff, Florida.

#### Genus *Nemocardium* Meek

1876. *Nemocardium* MEEK, U. S. Geol. Survey Territories, Rept., vol. 9, p. 167.

TYPE, BY MONOTYPY: *Cardium semi-asperum* Deshayes. Eocene of the Paris Basin, France.

"Shell closely resembling the typical forms of *Protocardia*, but thinner, with two-thirds to three-fourths of surface in front of the stronger posterior, usually echinate, radiating costae, occupied by fine, crowded, radiating striae, and the free margins crenate within all around; cardinal and lateral teeth generally rather slender; pallial line faintly sinuous, irregularly serrated, or nearly simple behind.—*Cardium semi-asperum* Deshayes." Meek, 1876.

Shell thin, inflated, orbicular-quadrate. Radial sculpture on the posterior area sharply differentiated from that on the medial and anterior portions of the shell. A small anterior and larger posterior cardinal in the right valve; a large anterior and smaller posterior cardinal in the left valve. Posterior muscle scar prominent. An incipient pallial sinus commonly present. Inner margins finely fluted.

*Nemocardium* is probably the Tertiary descendant of *Protocardia* Beyrich. It passed the crest of its development during the Eocene and is unknown in post-Miocene European faunas. In the Recent faunas of the West Indies, however, two species are recorded from waters of moderate depth.

#### *Nemocardium* sp.

Fragments indicating the characteristic sculpture of the genus but no specific characters are included in the collections from the lower Eocene, probably the upper part of the Midway formation at U.S.G.S. sta. 13462 (E-18), the downstream section of tilted shales on the Rio San Juan, China, Nuevo León.

#### *Nemocardium* sp.

Internal molds, similar to those of *N. nicolletti* Conrad but much smaller and too poorly preserved for positive identification, are common in the deposits of Jackson age at U.S.G.S. sta. 13503 (N-8), 20.8 kilometers S. 12° E. of Ciudad Camargo, Tamaulipas. The horizon is 150 feet above the Roma sand at the base of the Jackson.



*Nemocardium diversum* (Conrad)

- Jan., 1848. *Cardium diversum* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, p. 292.  
 Aug., 1848. *Cardium diversum* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 122, pl. 13, fig. 8.  
 1865. *Protocardia diversa* CONRAD, Am. Jour. Conchology, vol. 1, p. 7.  
     Not ?*Protocardia diversa* Conrad. GABB, Acad. Nat. Sci. Philadelphia, Proc., p. 370, 1861 = *Protocardia gambrina* Gabb  
 1900. *Protocardia diversa* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 5, pp. 1113, 1114.  
 1922. *Protocardia diversa* (Conrad). COOKE, U. S. Geol. Survey, Prof. Paper 129-E, p. 85.

"Trigonal, ventricose, subequilateral, thin, with concentric lines and more approximate fine but obtuse radiating lines; umbonial slope rounded, and the posterior space from the umbonial slope with profound radiating striae; posterior side slightly waved or contracted; summits very prominent; basal margin rounded in the middle, contracted posteriorly; posterior extremity subtruncated; inner margin densely crenate. Height 12-10. Length 13-10. Abundant." Conrad, 1848.

The species is described from Vicksburg.

*Nemocardium diversum* is remarkable among the lower Tertiary Gulf Nemocardia for its transversely elongate outline, sinuous base, and the high, narrow, simple radials that crowd the posterior slope.

Indeterminate molds of *Nemocardium* are present at a number of horizons in the Mexican section. Many from the Oligocene retain the characteristic outline and fragments of the diagnostic sculpture, and the reference to *N. diversum* may be made with some assurance.

In the Gulf region, *Nemocardium diversum* has been recovered from all the Oligocene horizons from the Red Bluff clay to the uppermost Byram marl.

DISTRIBUTION: Lower marine Oligocene sandstone: ?U.S.G.S. sta. 14056 (M-12). Upper Oligocene sandstone: ?U.S.G.S. sta. 13582 (O-25); ?U.S.G.S. sta. 13581 (P-25).

## Superfamily TELLINACEA

## Family TELLINIDAE

Genus *Tellina* (Linnaeus) Lamarck

1758. *Tellina* LINNAEUS, Systema naturae, 10th ed., p. 674.  
 1799. *Tellina* LAMARCK, Prodrome d'une nouvelle classification des coquilles, Soc. hist. nat., Paris, Mém., p. 84.

TYPE, BY SUBSEQUENT DESIGNATION (SCHMIDT, C. F., Versuch über die beste Einricht., etc., pp. 51, 177, Gotha, 1818): *Tellina radiata* Linnaeus. Recent in the West Indies.

Shell transversely ovate to ovate-trigonal in outline, compressed; usually rostrate and flexed to the right posteriorly and broadly depressed in front of the rostrum. Umbones low, subcentral or posterior, often opisthogyrate. External surface rarely smooth; dominant sculpture concentric, regular, and, as a rule, more or less incremental; radial ornamentation commonly suggested by the color pattern and by the reinforcing internal rays, rarely by the sculpture; oblique sculpture developed in one group. Ligament external, opisthodontic. Two cardinals, one of them bifid, developed in each valve, interlocking in the closed valves so that the bifid teeth are flanked on either side by a simple laminar tooth. Anterior and posterior laterals developed in some groups in both valves; in others, reduced to a single right anterior lateral. Sinus free or coalescent ventrally with the pallial line, often discrepant in the two valves, the dorsal margin of the sinus commonly uniting the anterior and posterior adductors.

The Tellinas are essentially a modern group, though they have their roots in the Mesozoic.

Indeterminate bivalves, probably tellinids, are widely distributed, though not locally abundant, in the lower Wilcox of northeastern Mexico. They are apparently without stratigraphic value.

*Tellina santander* Gardner, n. sp.

(Plate 4, figure 12)

1923. *Tellina* sp. A, GARDNER in TROWBRIDGE, U. S. Geol. Survey, Prof. Paper 131-D, p. 113, pl. 32, fig. 9.



Shell large, not very thin, compressed, and transversely ovate-trigonal, nearly equilateral. Umbones flat, inconspicuous except for their position at the apex of an angle of not far from  $120^\circ$ . Anterior and posterior dorsal margins nearly similar, the posterior declining a little more steeply. Lateral extremities rather sharply rounded. Base line symmetrically arcuate. An inconspicuous rostral fold developed near the posterior dorsal margin, defined rather by the abrupt change in the direction of the incrementals than by its elevation. Surface sculpture incremental, least feeble posteriorly and toward the base becoming abruptly stronger behind the rostral fold and indicating, by the undulation, a second very obscure fold. Characters of ligament and hinge not known. Adductor scars rather prominent. Pallial sinus obscure but apparently very deep, produced almost to the anterior adductor, not confluent below.

The species is decidedly larger than any other known in the Eocene of Texas or northeastern Mexico. A width of 40 millimeters is not uncommon, and one cast, presumably *T. santander*, is 40 millimeters high. Unfortunately, only casts, some of them with a few fragments of shell adhering, are preserved.

There was hope in 1923 that with further collecting better material might be found. Extensive collections have been made during the past 10 or 12 years, but the mode of preservation of the specimens continues to be uniformly poor. The species is a characteristic form of the Rio Grande Embayment, and it is herewith given the name used by the Conquistadores for the area in which it is found.

DIMENSIONS OF HOLOTYPE, A LEFT VALVE: Height, 26.0 millimeters; width, 38.5 millimeters.

HOLOTYPE: U. S. Nat. Mus. 352271.

TYPE LOCALITY: U.S.G.S. sta. 6436, Rio Grande at Rancho La Perla, 4 miles south of the Webb County line, Zapata County, Texas.

*Tellina santander* is possibly in the line of descent from *Tellina cherokeensis* Harris of the Weches of East Texas. The older species is higher relatively and, judging from the fragments which still remain, more strongly sculptured.

DISTRIBUTION: Laredo formation: middle Laredo, U.S.G.S. sta. 13479 (F-4); upper Laredo, U.S.G.S. sta. 13769 (G-3); U.S.G.S. sta. 13935 (H-3). Yegua formation: U.S.G.S. sta. 13752 (K-7); U.S.G.S. sta. 13735 (K-7).

#### *Tellina mooreana* Gabb

1860. *Tellina mooreana* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 387, pl. 67, fig. 56.

1865. *Tellina mooreana* Gabb. CONRAD, Am. Jour. Conchology, vol. 1, p. 4.

1891. *Tellina mooreana* Gabb. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, p. 401.

1900. *Tellina mooreana* Gabb. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 5, p. 1015 (part).

1919. *Tellina papyria* HARRIS, Bull. Am. Paleontology, vol. 6, p. 159 (part), pl. 49, fig. 10.

Not *Tellina papyria* Conrad, 1833.

1931. *Tellina papyria* var. *mooreana* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 104.

"Wide, flattened, nearly equilateral; beaks small, inclined internally; hinge line in advance of the beaks, straight, posterior slightly curved; surface smooth, or covered only by obsolete lines of growth.

"Dimensions.—Length .5 in., width .9 in., thickness .2 in.

"Locality.—Caldwell Co. One specimen, in my collection." Gabb, 1860.

TYPE: No. 13260, Academy of Natural Sciences, Philadelphia, Pennsylvania.

*Tellina papyria* Conrad, a probably synchronous species and, like *mooreana*, nearly equilateral, is a little larger and relatively higher than *mooreana*. Although the close relationship of the two species is recognized, the differences may perhaps be emphasized by the retention of Gabb's name for the western Gulf form. Harris suggests the possibility that *mooreana* "when full-grown may be the equivalent of the much heavier types along the Rio Grande," but the heavier types (*Tellina santander*) are restricted to the Rio Grande Embayment, and there is no evidence of immaturity in *mooreana*, which in east Texas and in the Rio Grande Embayment is 12 millimeters or more wide.

DISTRIBUTION: Laredo formation: middle Laredo, U.S.G.S. sta. 13986 (G-2); U.S.G.S. sta. 13772 (G-3), U.S.G.S. sta. 13977 (H-5); upper Laredo, ?U.S.G.S. sta. 13768 (G-3).

#### Subgenus *Tellinella* Mörch

1853. *Tellinella* MÖRCH, Catalogus Conchyliorum quae reliquit D. Alphonso d'Aguirra et Gadea Comes de Yoldi, fasc. 2, p. 13.



TYPE, BY SUBSEQUENT DESIGNATION (STOLICZKA, *Palaeontologia Indica*, Cretaceous Fauna of Southern India, vol. 3, p. 116, 1871): *Tellina virgata* Linnaeus. Recent in the Indo-Pacific. The name "*Tellinella*" was credited by Mörch to "Gray, 1852." The name may have been taken from a manuscript label, but no mention of it can be found in any of Gray's published papers.

Shell subequivalve, transversely ovate to ovate-trigonal, posteriorly rostrate. Umbones low, subcentral, feebly opisthogyrate. Sculpture concentric, lirate, or laminar. Ligament external, elongated parallel to the dorsal margin. Two cardinals and anterior and posterior laterals developed in each valve, the left laterals, however, often nothing more than the modified dorsal margins. Pallial sinus very deep but only partially coalescent ventrally with the pallial line, its dorsal extremity falling short of the anterior adductor.

*Tellina (Tellinella?)* sp.

(Plate 7, figure 19)

Transversely ovate-trigonal, compressed molds and paired valves from the lower Claiborne probably represent an undescribed species. The small, pointed umbones are median or slightly posterior. The anterior portion of the shell is semielliptical, the posterior constricted behind the umbones and relatively narrow at the lateral extremity. The base line approaches the horizontal. There is no lunule, but a linear escutcheon runs the length of the dorsal margin. A narrow, warping fold directly in front of the escutcheon is better developed on the right valve than on the left. The shell is adherent over a large part of the surface of the mold, moderately thin, and concentrically striated. The interior is not accessible, and the hinge and musculature are not known.

The figured left valve, U. S. Nat. Mus. 496334, is 16.3 millimeters high and 30 millimeters (estimated) wide. The collection was made at U.S.G.S. sta. 13685 (H-9), Los Aldamas, 1½ kilometers east of El Barrio on Rio San Juan, Nuevo León.

The general aspect of the shell recalls *Tellina linifera* Conrad, but the Claiborne species is lower and the beaks are less posterior.

DISTRIBUTION: Laredo formation: middle Laredo, U.S.G.S. sta. 13685 (H-9); U.S.G.S. sta. 13570 (H-12).

*Tellina (Tellinella?)* sp.

(Plate 7, figure 11)

An interior mold of the right valve of a very fine and apparently undescribed *Tellina* is unusual in outline and may be recognizable if found elsewhere. The shell was thin, and the surface sculpture is reflected on the mold. The beaks are subcentral, the anterior portion of the shell semielliptical, the posterior cuneate, the posterior dorsal slope about 30°. A few fragments of finely, sharply sculptured shell adhere near the posterior dorsal margin. The pallial sinus may be traced dimly through a part of its extent. It reaches almost to the anterior scar and is confluent with the pallial line posteriorly but not anteriorly. The hinge is unknown.

DIMENSIONS OF FIGURED SPECIMEN: Height, 20.5 millimeters; width, 38 millimeters.

FIGURED SPECIMEN, A RIGHT VALVE: U. S. Nat. Mus. 496117.

Locality: U.S.G.S. sta. 13643 (M-25); 2700 meters northeast of Rancho El Prieto, San Fernando, Tamaulipas. Middle part of the Laredo formation.

This must have been an unusually fine species. The outline and the character of the pallial sinus are those of the subgenus *Tellinella* Mörch.

Genus *Apolymetis* Salisbury

1856. *Metis* H. AND A. ADAMS, *Genera of Recent Mollusca*, vol. 2, p. 399.

Not *Metis* Philippi, 1843; Crustacea. Not *Metis* Gistel, 1848, Echinodermata.

1929. *Polymetis* SALISBURY, *Mal. Soc. London, Proc.*, p. 255.

Not *Polymetis* Walsingham, 1903, Insecta.

1929. *Apolymetis* SALISBURY, *Mal. Soc. London, Proc.*, p. 258.

TYPE, BY MONOTYPY AND ORIGINAL DESIGNATION: *Tellina meyeri* Dunker. Recent in the East Indies.

*Apolymetis* covers a group of rather thin inequivalve shells of moderate dimensions, transversely ovate or ovate-trigonal in outline, compressed and warped by the broad shallow depression in front of the posterior rostrum. The concentric sculpture is incremental and may or may not be netted by a



radial lineation. The ligament is short and strong. The simple anterior and heavy bifid posterior cardinal in the right valve, and heavy anterior and simple laminar posterior cardinal in the left valve, are clasped in the closed valves so that the two heavy cardinals are in the middle with a simple laminar cardinal on either side. In *Apolymetis*, s.s., there are no laterals. The anterior adductor is narrow but produced parallel to the outer edge, the posterior adductor, rudely quadrate. The pallial sinus is broad and deep and wholly or in part free from the pallial line.

The genus originates in the mid-Tertiary and continues to hold a minor place in the shallow-water faunas of the tropical seas.

*Apolymetis* sp.

Molds presenting the compressed and warped outline of *Apolymetis* occur in the upper Oligocene limestone at U.S.G.S. sta. 14033 (P-25), 2.2 kilometers northwest of Mendez, Tamaulipas. The hinges and scars are not preserved so that positive identification cannot be made. The molds are relatively lower than *Metis trinitaria* Dall, from the Oligocene of the West Indies, and the best preserved measures about 25 millimeters high by 33 wide.

Genus *Strigilla* Turton

1822. *Strigilla* TURTON, *Conchylia insularum britannicarum*, Dithyra, p. 117.

TYPE, BY SUBSEQUENT DESIGNATION (HERRMANNSEN, *Indicis generum malacozoorum*, vol. 2, p. 508, February, 1849): *Tellina carnaria* Linnaeus. Recent on the east coast from Hatteras to Brazil.

Shell of medium size and convexity, subovate to subcircular. Surface sculpture oblique over all or a part of the valve. Lunule and escutcheon defined but very narrow. Ligament external. Hinge of right valve armed with two discrepant cardinals of which the posterior is the larger and is usually bifid, and with anterior and posterior laterals. Hinge of left valve with 2 slender cardinals, the anterior bifid, and anterior and posterior laterals. Pallial sinus varying widely within the limits of the genus but confluent with the pallial line below and, in the typical section, uniting the adductor scars above.

*Strigilla* is one of the few genera characterized by an oblique sculpture. *Divaricella* is another, but, aside from the fundamental hinge and sinus differences, *Divaricella* is the heavier, and the outline is more nearly circular. *Divaricella* is sculptured by grooved concentric chevrons with the axis of the angle directed obliquely downward and forward from the umbo, while in *Strigilla* the grooves sweep obliquely downward and backward across the disk from the anterior dorsal margin to the posterior area where they break into a series of crowded zigzags.

The genus has a meager representation in the Tertiary and in the warm waters of the Recent seas. All the east coast Tertiary species are referred to *Strigilla*, s.s.

*Strigilla?* sp.

A mold of a single right valve about 7 millimeters high and almost 7 millimeters wide was recovered from beds of middle Laredo age at U.S.G.S. sta. 13634 (M-24). It still retains a few fragments of a thin and delicate shell with the distinctive and characteristic sculpture of *Strigilla*. The form of the shell is that of *Strigilla* in miniature.

*Strigilla* sp.

Molds retaining the characteristic sculpture of the genus are included in the collection from U.S.G.S. sta. 13732 (T-16), the south end of the Llorona Dam, 10 meters west of Campo Llorona, Hacienda Rio Bravo, Reynosa, Tamaulipas. The species is not determinable. Associated crab remains are common, and the horizon is probably near that of the Guajalote formation.

Family GARIDAE

Genus *Gari* Schumacher

1817. *Gari*, SCHUMACHER, *Essai d'un nouveau système des habitations des vers testacés*, p. 131, pl. 9, fig. 2.

1818. *Psammobia* LAMARCK, *Histoire naturelle des animaux sans vertèbres*, vol. 5, p. 511.

1930. *Gari* Schumacher. STEWART, *Acad. Nat. Sci. Philadelphia*, Spec. Pub. 3, p. 280.



TYPE, BY TAUTONYMY: *Gari vulgaris* Schumacher = *Tellina gari* Linnaeus, Spengler and Chemnitz = *Tellina fervensis* [*ferröensis*] Gmelin. Recent in north European waters.

Shell of moderate dimensions and thinness, compressed, transversely elongated, slightly gaping posteriorly. Umbones subcentral, inconspicuous, flattened, and turned slightly backward. Dorsal margins gently sloping. Anterior extremity rounding smoothly into the almost horizontal base. Posterior end truncate from the dorsal margin to the posterior keel; base slightly insinuated in front of the keel. Sculpture feeble, restricted on the medial portion of the disk to faint incrementals; stronger anteriorly and, in the type species, sharply elevated posteriorly; a few faint radial rays also discernible on the posterior area of the type. Ligament strong, external, opisthodetic. Dental formula inconstant; in the type section, two short cardinals diverging beneath the umbones, the posterior cardinal of the right valve and the anterior cardinal of the left valve bifid. Adductor scars large, distinct. Pallial sinus broad, the anterior extremity in line with the umbones, confluent ventrally with the rather deep pallial margin.

The Recent species are not numerous but have a wide distribution in the shallow waters. The presence of the genus in the Cretaceous has not been established, but by the mid-Eocene it seems to have occupied a position in the fauna comparable to that which it holds in the Recent biota.

*Gari* sp. cf. *G. eborea* Conrad

(Plate 7, figures 1, 3)

Synonymy and description of *Gari eborea* Conrad:

1833. *Psammobia eborea* CONRAD, Fossil shells Tertiary formations of North America, p. 42.  
 1865. *Gari* (*Psammacola*) *eborea* CONRAD, Am. Jour. Conchology, vol. 1, p. 4.  
 1900. *Psammobia eborea* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 5, pp. 976, 978.  
 1919. *Psammobia eborea* Conrad. HARRIS, Bull. Am. Paleontology, vol. 6, p. 156, pl. 48, figs. 8-11.

"Shell oblong-oval, compressed; posterior side longest and obliquely truncated at the end; dorsal margin straight; beaks slightly prominent." Conrad, 1833.

The specimen is presumably from the Claiborne sand.

The comparative material is inadequate, and the specimens from the middle part of the Laredo formation of Mexico are poorly preserved, but their characters agree fairly well with *G. eborea* as we know it from illustrations and imperfect material. Both the Mexican specimens figured are paired and locked valves. The outline is rudely elliptical, the slight inflation along the vertical rather than along the horizontal axis. The umbones are low and flat, scarcely interrupting the line of the dorsal margins. The posterior dorsal margin is almost parallel to the nearly horizontal base. The slope of the anterior dorsal margin is slightly more pronounced. The anterior extremity is broadly rounded, the posterior truncate. Even the incremental sculpture is almost obsolete on the disk and feeble anteriorly, but behind the obtuse posterior keel there are a few strong rugae. The nymphs are obvious and produced about half the length of the dorsal margin. The hinge and interior are not accessible.

DIMENSIONS OF FIGURED SPECIMENS: Height of larger form, 16 millimeters; width of larger form, 30 millimeters (estimated); convexity of larger form, 9.5 millimeters. Height of smaller form, 15.5 millimeters; width of smaller form, 28 millimeters (estimated); convexity of smaller form, 8.0 millimeters.

FIGURED SPECIMENS: U. S. Nat. Mus. 496119 (larger); 496118 (smaller).

LOCALITY OF FIGURED SPECIMENS: U.S.G.S. sta. 13570 (H-12), General Bravo, Carlos Cantú, Nuevo León. Middle part of Laredo formation.

*Incertae sedis*

(Plate 7, figures 4, 12)

Shell thin, apparently not nacreous, broadly elliptical to obliquely ovate, probably slightly gaping posteriorly and possibly anteriorly; compressed. Umbones within the anterior half evenly but not strongly inflated, the tips incurved and in contact, turned forward?. No trace of lunule or escutcheon. Anterior portion of shell slightly contracted in front of the umbones, shorter than the posterior but,



like the posterior, broadly and nearly symmetrically rounded. Surface sculpture incremental only, strongest toward the ventral and lateral margins. Characters of hinge and sinus not known.

**DIMENSIONS OF FIGURED SPECIMENS:** Larger specimen, height, 24 millimeters; width, 29.5 millimeters; convexity 12.5 millimeters. Smaller specimen, height, 22.5 millimeters; width, 27 millimeters; convexity, 12.0 millimeters.

Larger figured specimen, U. S. Nat. Mus. 496273. Smaller figured specimen, U. S. Nat. Mus. 496272.

**LOCALITY OF FIGURED SPECIMENS:** Laredo formation, middle Laredo: U.S.G.S. sta. 13570 (H-12), General Bravo, Carlos Cantú, Nuevo León.

#### *Incertae sedis*

Molds of transversely elongated tellinids or garids representing probably more than one species are common in the indurated sandstone of the Jackson formation at U.S.G.S. sta. 13503 (N-8), 20.8 kilometers S. 12° 30' E. of Ciudad Camargo, Tamaulipas. The horizon is 150 feet above the Roma sand. One of the molds on which the outline is best preserved is 17 millimeters high and 29 millimeters wide. The beaks are inconspicuous, inclined slightly backward, and fall a little behind the median vertical. The apical angle is not far from 130°, and the posterior dorsal margin slightly higher than the anterior. The larger molds are somewhat warped so that the anterior portion is less compressed than the posterior. The posterior extremity is obtusely rostrate and broadly truncate. There is no evidence of laterals except possibly on one mold, and probably most of the forms should be referred to *Gari*. The scar of the pallial sinus cannot be traced.

#### Family DONACIDAE

##### Genus *Donax* (Linnaeus) Lamarck

1758. *Donax* LINNAEUS, Systema naturae, 10th ed., p. 682.

1799. *Donax* LAMARCK, Prodrome d'une nouvelle classification des coquilles: Soc. Hist. nat. Paris Mém., p. 85.

1847. *Donax*, GRAY, Zool. Soc. London, Proc., pt. 15, p. 187.

Type, by subsequent designation (Schmidt, C. F., Versuch über die beste Einricht., etc., pp. 55, 176, Gotha, 1818): *Donax rugosa* Linnaeus. Recent in the West Indies.

Shell rather solid, moderately inflated, of varying dimensions, elongate cuneate to trigonal to sub-cylindrical in outline. Umbones subcentral to posterior, opisthogyrate. Sculpture finely radial, commonly subcutaneous, in some shells punctate. Ligament both external and internal; external ligament short, heavy, inset; the resilium seated on short, usually excavated nymphs. Dentition rather rude; normally two cardinals in each valve, one of them commonly bifid; laterals varying widely in strength and relative position within the genus. Pallial sinus deep, partly confluent ventrally with the pallial line. Inner margins serrate.

The genus is remarkably uniform and well characterized by its solid, more or less pronounced cuneate and flexuous valves, opisthogyrate and usually posterior umbones, and serrate inner margins. The earliest known occurrence of the genus is in the Eocene. The living species, about 100 in number, inhabit the sandy beaches of the warm and tropical seas. They are lovely little bivalves, ornamented with varicolored rays on a dull-gray or dun background. The "pampalone shells," as they are called along the Florida coast, where they are particularly abundant, are used to a considerable extent for food.

#### *Donax* sp.

A small *Donax* recalling in measurements and form *D. funerata* Conrad, 1847, is rare in the lower marine Oligocene sandstone at U.S.G.S. sta. 13510 (M-11), 1035 meters south and 305 meters east of Rancho La Copa, Hacienda Zacate, General Bravo, Nuevo León.

#### Superfamily SOLENACEA

#### Family SOLENIDAE

##### Genus *Solena* Mörch

1853. *Solena* MÖRCH, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra et Gadea Comes de Yoldi, fasc. 2, p. 7.



TYPE, BY MONOTYPY: *Solen obliquus* Spengler, 1794 = *Solen ambiguus* Lamarck, Recent in the Caribbean.

The beaks in *Solena* are not terminal as they are in *Solen* Linnaeus but are set back from the anterior extremity a distance of about one sixth of the entire length of the shell. *Solena* is further characterized by the short broad anterior adductor scar. In *Solen* the area of attachment is narrow but produced backward parallel to the dorsal margin almost to the median line.

Only the subgenus *Eosolen* has been recognized in the Tertiary of the Western Gulf.

#### Subgenus *Eosolen* Stewart

1930. *Eosolen* Stewart, Acad. Nat. Sci. Philadelphia Spec. Pub. No. 3, p. 290.

TYPE, BY ORIGINAL DESIGNATION: *Solen obliquus* Deshayes, 1860, not Spengler, 1794 = *Solen plagiaulax* Cossmann, 1886. Eocene of the Paris Basin.

"The Eocene *Solena*, as represented by *Solen plagiaulax* (Cossmann and Pissarro, 1906, pl. 2, fig. 11-5, Lutétien-Bartonien) and *Solen lisbonensis* (Harris, Bull. Am. Pal. v. 6, 1919, p. 195, pl. 59, fig. 2) have a distinct umbonal furrow which is absent on typical *Solena*. These species are like *Solena* in being produced anteriorly but they also resemble the living European species *Solen marginatus* (Bucquoy, Dautzenberg and Dollfus, Mol. Roussillon, v. 2, 1895, p. 495, pl. 72, fig. 1-3) which, though it has the furrow, is not produced anteriorly. The anterior muscle scar, however, is short and wide as in *Solena* and not elongated as in *Solen marginatus* and the group is therefore placed under *Solena*. The new subgeneric name *Eosolen* is proposed for this group with *Solen obliquus*, as figured by Deshayes, as type species (Desc. Anim. sans Vert. Bassin Paris, v. 1, 1860, p. 153, pl. 7, fig. 1-3 "Calcaire grossier: sables moyens.") Deshayes recognized its resemblance to the Caribbean species. The correct name for this type species is evidently *Solena plagiaulax* (Cossmann) (Jr. de Conch., v. 34, 1886, p. 102 as *Solen*) which is a new name for *Solen obliquus* Sowerby (Min. Conch. Gt. Brit. v. 7, 1844, p. 75, pl. 641, fig. 2a-c, Bracklesham Bay, Eocene) not Spengler. *Eosolen* is apparently confined to the Eocene." Stewart, 1930.

*Eosolen* makes an interesting addition to the rather short list of specialized forms of narrow stratigraphic range and transoceanic distribution. Neither in the Gulf nor in the Anglo-Parisian deposits is there any record of the group before the middle Eocene.

#### *Solena (Eosolen) lisbonensis* (Aldrich)

1886. *Solen lisbonensis* ALDRICH, Geol. Survey Alabama, Bull. 1, p. 37, pl. 4, fig. 4.

1900. *Solen (Plectosolen) lisbonensis* Aldrich. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 5, p. 953.

1919. *Solen lisbonensis* Aldrich. HARRIS, Bull. Am. Paleontology, vol. 6, p. 195, pl. 59, fig. 2.

"Shell linear, nearly straight; posterior sub-truncate; anterior obliquely rounded with a depressed space behind running to the beaks; lines of growth prominent, bending at right angles along a line running obliquely from the beaks to the junction of the posterior and ventral margins. Anterior widely gaping.

"*Locality*.—Lisbon, Ala., just above the Buhrstone." Aldrich, 1886.

HOLOTYPE: Paleontological Laboratory, Johns Hopkins University, Baltimore, Maryland.

*Solena lisbonensis*, s. s. has not been recognized in the Mexican section, but a closely related form, possibly the subspecies *abruptus* Dall, occurs in the Laredo formation near Mier, Tamaulipas.

#### *Solena (Eosolen) lisbonensis abruptus* (Dall)?

Synonymy and description of *Solena (Eosolen) lisbonensis abruptus* Dall:

1900. *Solen (Plectosolen) lisbonensis* var. *abruptus* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 5, p. 953.

"This form, represented by numerous fragments, differs from Aldrich's figure by its more abrupt anterior truncation and relatively wider valves. It will probably, when more complete specimens are obtained, prove to belong to a distinct species." Dall, 1900.

TYPE LOCALITY: McLeod's Mill on Suanlove Creek, Clarke County, Mississippi.

Unfortunately such complete specimens have not yet been found, but the differences seem to be valid, and they characterize a slightly later development. The horizon, from which Aldrich's type



was recovered, has been correlated with the Mount Selman formation, whereas the exposure at McLeod's Mill falls within the probable equivalent of the Laredo formation of the western Gulf. The Mexican material is fragmentary and contributes little to our knowledge of the species. A number of fragments indicating the width and the outline of the lateral margins were collected from the middle Laredo at U.S.G.S. sta. 13772 (G-3), 5780 meters N. 44° W. of the church tower in Mier, Tamaulipas, Mexico.

Superfamily MACTRACEA

Family MACTRIDAE

Subfamily MACTRINAE

*Incertae sedis*

Molds of a small mactroid, a centimeter or more in height and 1½ centimeters in width, occur in abundance in the lower marine Oligocene sandstone of northeastern Mexico at U.S.G.S. sta. 13522 (M-11). The fragments of shell adhering to the molds indicate a lack of sculpture, similar to that of the smaller *Spisula funerata* Conrad, 1847, which is smooth except for incrementals most strongly developed toward the dorsal margins. The hinge in the Mexican species is not preserved.

*Incertae sedis*

Internal molds of small mactroids are abundant in the soft yellow sandstones of the Guajalote formation at U.S.G.S. sta. 13586 (V-29), 11,500 meters N. 30° W. from San Fernando, Tamaulipas. They are about 10 millimeters high and 15 millimeters wide, and the posterior area is sharply defined by the angulation of the shell. A few imperfect impressions of the exterior surface indicate a strong growth sculpture with conspicuous resting stages. The hinge characters are not preserved. Though the forms are not determinable even generically, the mode of their abundant occurrence recalls *Spisula* (*Hemimactra*) *densa* of the Oak Grove fauna and *Spisula* (*Hemimactra*) *craspedota* of the Shoal River fauna of Florida. Both these Alum Bluff species, however, are lower and less inequilateral than the mactroid from the Guajalote formation.

Subfamily PTEROPSINAE

Genus *Pteropsis* Conrad

1860. *Pteropsis* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 296.

TYPE, BY MONOTYPY: *Lutraria papyria* Conrad. Claiborne group of Alabama.

Shell thin and brittle, equivalve, evenly but not strongly inflated. Beaks anterior or subcentral, rather flat with narrow pointed tips turned inward and forward. Dorsal margins rather steeply descending and meeting the upcurved arcuate base line with no sharp differentiation of the lateral margins. Lunule and escutcheon not defined; a narrow posterior area indicated by the weakening or disappearance of the concentric sculpture and by a thin raised thread which follows the irregularities of surface and may be interrupted by them. Outer surface rippled by the concentric sculpture, vermicular in the genotype. External portion of ligament very short, not cut off from the internal ligament; chondrophore deltoid and rather shallow. Hinge armature strong, that of the left valve not well preserved in available material. Cardinal teeth united to form a reversed L, the angle directly under the tip of the umbone, the short anterior base appressed against the dorsal margin, the upright forming the wall between the chondrophore and the dental socket in front of it. Claspings laterals strong, concentrated, the ventral spur of the anterior lateral functioning as the anterior wall of the dental socket. Adductor scars large for so delicate a shell. Pallial line indistinct but not far from the ventral margin. Pallial sinus a long narrow tongue produced almost to the anterior adductor scar.

*Pteropsis* is restricted in its known distribution to the Eocene of the Gulf Province. Only a very few species have been recognized, but the individuals are fairly numerous and widely distributed.

*Pteropsis lapidosa* Conrad

(Plate 9, figure 32)

1846. *Lutraria lapidosa* CONRAD, Am. Jour. Sci., 2d ser., vol. 1, p. 215, pl. 1, fig. 7.  
 ?1863. *Astarte Conradi* DANA, Manual of geology, pp. 516, 517, fig. 800.



1865. *Pteropsis lapidosa* CONRAD, Am. Jour. Conchology, vol. 1, p. 4.  
 ?1884. *Astarte Conradi* "(= young of *Crassatella alta*)" HEILPRIN, Acad. Nat. Sci. Philadelphia, Jour., vol. 9, p. 152.  
 1886. *Astarte Conradi* Dana. ALDRICH, Geol. Survey Alabama, Bull. 1, p. 39, pl. 4, fig. 7.  
 ?1894. *Pteropsis Conradi* DANA, Manual of geology, 4th ed., p. 897, fig. 1483.  
 1894. *Pteropsis lapidosa* Conrad. DANA, Manual of Geology, 4th ed., p. 916 (name included in check list of Lower Claiborne characteristic fossils).  
 1896. *Pteropsis conradi* Dana. VAUGHAN, U. S. Geol. Survey, Bull. 142, pp. 20, 48.  
 1898. *Pteropsis lapidosa* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 881.  
 1919. *Pteropsis lapidosa* Conrad. HARRIS, Bull. Am. Paleontology, vol. 6, p. 178, pl. 54, figs. 14, 15.

"Obliquely ovate, convex, with rather distinct large concentric sulci, obsolete towards the base; summits very elevated, from which the anterior and posterior dorsal margins decline very obliquely; anterior extremity angulated; posterior side cuneiform towards the end margin, which is acutely rounded or subangulated; anterior basal margin very oblique, subtruncated. Orangeburg, S. C." Conrad, 1846.

"Shell thin, oblong-ovate, concentrically wrinkled with broad, rounded plait, concavities between nearly smooth. Covering the whole surface are fine, concentric lines, stronger on top of the plications; beaks flattened, blunt, and turned toward the anterior; lunule heart-shaped, separated by an indistinct ridge; hinge line nearly straight.

"Localities.—Lisbon, Coffeetown, and beds at base of Claiborne Bluff, Ala.

"The dentition removes this species to *Lutraria*. . . . The largest specimen found measures nearly two inches in length. Very close to *L. lapidosa*, Con." Aldrich, 1886.

The shells are so rarely preserved that much of the detail on which specific separations is based has been lost. It is quite possible that more than one unit is represented in our northeastern Mexican Claiborne faunas. The species, in the broad sense, occurs in at least two horizons, and almost without exception those from the lower bed are preserved in the form of molds of the single valve, those from the upper bed in the form of molds of the double valves. Possibly a more effective hinge closure was developed by the later species. Strong currents would have reduced shells so thin and brittle to fragments, and, for that reason, the separation of the valves in the lower horizon can scarcely be explained by disturbed waters.

The figured specimen (U. S. Nat. Mus. 496271 from U.S.G.S. sta. 13565, H-12) has doubtless been warped. It now measures 23.5 millimeters in height; 30 millimeters in width; and 15 millimeters in the convexity of the double valves.

The left valve (U.S. Nat. Mus. 496274) from U.S.G.S. sta. 13570 (H-12), (Pl. 9, fig. 30) may be referable to this or a closely allied species. The rippling of the shell is similar, but the outline is much more regular and more symmetrical.

DISTRIBUTION: Laredo formation: lower Laredo, U.S.G.S. sta. 13617 (H-18); U.S.G.S. sta. 13969 (I-19); U.S.G.S. sta. 13625 (J-20); middle Laredo, U.S.G.S. sta. 13479 (F-4); U.S.G.S. sta. 13990 (H-9); U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. ?13570 (H-12); upper Laredo, U.S.G.S. sta. 13769 (G-3); U.S.G.S. sta. 13943 (H-3); U.S.G.S. sta. 13958 (H-3). Yegua formation: U.S.G.S. sta. 13964 (H-6); U.S.G.S. sta. 13751 (K-6).

#### Family MESODESMATIDAE

#### Genus *Mesodesma* Deshayes

1831. *Mesodesma* DESHAYES, Encyclopédie méthodique, Vers, vol. 2, p. 442.

TYPE, BY SUBSEQUENT DESIGNATION (ANTON, Verzeichniss der Conchylien, p. 3, Halle, 1839): *Macra donacia* Lamarck. Recent off the coast of Chile.

Shell heavy, compressed, donaciform or subtrigonal, inequilateral. Umbones posterior. Ligament short, mostly internal; hinge strong; resilial pit deep; a single cardinal in each valve, that of the left usually stronger and often bifid; anterior and posterior sulcated laterals in the left valve received between the sulcated laminae of the right. Inner margins of valves smooth. Muscle impressions deep. Pallial sinus well defined, variable.

The genus is first recognized in the Eocene. The Recent species are relatively few in number, but they are world wide in distribution.



*Mesodesma singleyi* (Harris)

(Plate 7, figure 6)

1894. *Ceronia singleyi* Harris. DUMBLE, Jour. Geology, vol. 2, p. 553 (name only).  
 1895. *Ceronia singleyi* HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 52, pl. 3, figs. 3, 3a.  
 1898. *Ceronia singleyi* Harris. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 910, 912.  
 1915. *Ceronia singleyi* Harris. DUMBLE, Geol. Soc. Am., Bull., vol. 26, p. 453.

"General form as figured; beaks prominent, turned anteriorly; anterior side often very elongate; posterior generally short, obtusely pointed with an obtuse angle midway of the posterior dorsal margin; umbonal ridge rounded; post-umbonal slope of considerable width and nearly at right angles to the face of the valve; substance of the valve moderately thick.

"*Locality*.—Sunnyside Church, Lee Co., Texas.

"*Geological Horizon*.—Lower Claiborne Eocene [error for Jackson Eocene].

"*Type*.—Texas State Museum." Harris, 1895.

The Mexican shell, which is very similar to figure 3a of Harris, is known from the molds alone. The figured specimen, a left valve, U. S. Nat. Mus. 496339, is 30 millimeters high and 43 millimeters wide. The beaks, which are high and pointed for the group, are placed near the limit of the posterior third. The wide anterior portion of the shell is broadly rounded and relatively compressed; the more inflated posterior portion abruptly truncate. The growth lines were apparently strong toward the margins. Vestiges of lateral sockets still remain, but other hinge characters are not known.

The species is rather widely distributed in the middle Jackson sands and sandstones of south-central Texas. Although the preservation is imperfect, the outline and warping of the molds are sufficiently characteristic to isolate the form. Its occurrence in the Roma sand is a significant link between that and the Wellborn, the outcropping formation at the type locality in Lee County, Texas.

DISTRIBUTION: Jackson formation: Roma sand, U.S.G.S. sta. 13753 (K-7).

## Superfamily VENERACEA

## Family VENERIDAE

Genus *Macrocallista* Meek

1876. *Macrocallista* MEEK, U. S. Geol. Survey Territories, Rept., vol. 9, p. 179.

TYPE, BY MONOTYPY: *Venus gigantea* Gmelin = *Venus nimbose* Solander. Pliocene and Pleistocene of the Carolinas and Florida; Recent on the east coast from Hatteras to the Florida Keys and west to Texas.

The group was isolated by Meek as a section of *Callista*.

Shell transversely ovate-trigonal, solid, porcellaneous, highly polished, for the most part smooth; in the Recent species, commonly with a vivid radial color pattern, and vernicose periostracum. Lunule sunken, defined by an incised groove, slightly wider in the right valve than in the left. Escutcheon obscurely indicated. Ligament groove deeply inset; almost half the length of the dorsal margin. Three cardinals in each valve, the anterior and middle cardinal of the right valve with parallel, proximate faces, the posterior obliquely produced and sulcate; anterior and medial cardinal of left valve joined in an inverted V, the anterior prong vertical and laminar; posterior cardinal laminar, obliquely produced; the short anterior lateral of the left valve received in the clasping socket of the right. Muscle scars usually distinct. Pallial line fairly distinct, the sinus in *Macrocallista*, s. s., broad and U-shaped, with an approximately horizontal axis. Area of adherent mantle thickened in many specimens. Inner valve margins smooth.

The genus includes a considerable number of large and attractive Tertiary and Quaternary species, inhabitants chiefly of the warmer seas.

The group is distinguished among the venerids by the sleek outline, the highly polished shell, the broad and broadly rounded sinus almost horizontally directed. *Callocardia* is more chalky, higher, and more inflated, with a less broad, obliquely directed sinus.

Subgenus *Chionella* Cossmann

1886. *Chionella* COSSMANN, Soc. Royale Malacolog. Belgique Annales, vol. 21, p. 105.  
 1909. *Paradione* DALL, Malacolog. Soc. London, Proc., vol. 8, p. 197.  
 1930. *Chionella* Cossmann. STEWART, Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, p. 241.



TYPE BY SUBSEQUENT DESIGNATION (CROSSE, Jour. Conchyliologie, [3d ser., vol. 26], vol. 34, p. 331, 1886): *Cytherea ovalina* Deshayes. Calcaire grossier of the Paris Basin.

Shell smaller than *Macrocallista*, thinner-shelled but dense; less elongate transversely and not so narrow in front. Characters of lunule and ligament similar to those of *Macrocallista*. Posterior cardinals less produced, but hinge characters otherwise similar. Outline and inclination of pallial sinus varying rather widely within the group.

*Macrocallista* (*Chionella*?) sp.

A small heavy species from the lower or middle Jackson of Tamaulipas suggests, in its compressed and inconspicuous umbones, *Macrocallista sobrina* (Conrad) of the Vicksburg. It is smaller than the Vicksburg species and lower and presents a somewhat dwarfish outline. The best-preserved valve is 14.5 millimeters high and 21 millimeters wide. The apical angle is a little more than 90°. The umbones are in front of the medial line so that the anterior dorsal slope is steeper than the posterior. The base line is broadly arcuate. There is a narrow lunule set off by an impressed line but no defined escutcheon. The outer surface is incrementally striated, and there are a few resting stages toward the ventral margin. The hinge is not accessible. A short pallial sinus is vaguely traceable on one mold. The form is abundant in the sandstone at U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7° 30' E. of Ciudad Camargo, Tamaulipas, and adequate type material may later be found.

The shell is heavier than that of the subgenotype, possibly too heavy to be included under *Chionella*, and has much in common with that of *M. (C.) cantui* Gardner from the Oligocene. The Eocene species is lower and less trigonal, however, than that of *cantui*, but there may well be a genetic relationship.

*Macrocallista* (*Chionella*) *cantui* Gardner, n. sp.

(Plate 10, figures 7-9, 11, ?13-?14)

Shell transversely ovate-trigonal, rather solid. Beaks not very prominent nor very far in advance of the medial line, bent forward over a lunule defined by a faintly incised line. Posterior extremity more broadly rounded than the anterior. Outer surface smooth except for rather prominent growth lines and vestiges of a radial color pattern. Ligament deeply inset, short, less than half the length of the posterior dorsal margin. Hinge plate moderately heavy, sinuous. Anterior and medial right cardinals short, vertical, their inner faces flattened and proximate; the posterior right cardinal deeply sulcate, obliquely produced; anterior and medial left cardinals united in an asymmetric inverted V, the anterior arm sufficiently thin and laminar to be received between the flattened faces of the anterior and medial teeth of the right valve; posterior left cardinal merged with the inner margin of the ligament nymph; short anterior lateral of left valve, placed close to the cardinals, received between the clasping lamellae of the right valve. Muscle scars deeply impressed, of moderate dimensions. Pallial line not very close to the margin, the sinus fairly short, linguiform, the axis directed toward the anterior lateral. Inner margins simple.

DIMENSIONS OF COTYPES: Right cotype, height, 13.3 millimeters; width, 16.0 millimeters. Left cotype, height, 10.6 millimeters; width, 13.9 millimeters.

COTYPES (2), RIGHT AND LEFT VALVES OF DIFFERENT INDIVIDUALS: U. S. Nat. Mus. 496335.

TYPE LOCALITY: U.S.G.S. sta. 13505 (N-8). 21 kilometers S. 25° 30' E. of Ciudad Camargo, Tamaulipas. Lower marine Oligocene sandstone.

The species name recalls Capt. Carlos Cantú, who led from the pueblo of Camargo a few families to form the nucleus of the settlement of Reynosa.

In addition to the cotypes, there are two figured specimens (U. S. Nat. Mus. 496336 and 496338), probably referable to the same species, from U.S.G.S. sta. 13518 (N-10). The larger is 12.4 millimeters high and 15 millimeters wide; the smaller, 9 millimeters high and 12 millimeters wide. A possible juvenile of the species (U. S. Nat. Mus. 496337) is 5 millimeters high and 6 millimeters wide.

*Macrocallista* (*Chionella*) *cantui* has much in common with *M. (C.) sobrina* (Conrad) from Vicksburg. The Mississippi species, however, is decidedly higher and heavier, the umbones more inflated and flattened at their tips.

DISTRIBUTION: Lower marine Oligocene sandstone: U.S.G.S. sta. 13505 (N-8); U.S.G.S. sta. 13518 (N-10); U.S.G.S. sta. 13521 (M-10); U.S.G.S. sta. 13510 (M-11).



Genus *Callocardia* A. Adams

1864. *Callocardia* A. ADAMS, Annals Mag. Nat. Hist., 3d ser., vol. 13, p. 307.

TYPE, BY MONOTYPY: *Callocardia guttata* A. Adams. Recent in the China Sea.

Shell ovate to subtriangular. Umbones anterior, involute. Lunule circumscribed by a faintly incised line. Escutcheon not delimited. Ligament external, lodged in a deep groove. Nymphs prominent. Exterior sculpture concentric. Three more or less discrepant cardinals in each valve, commonly bifid or cuspid; two lateral lamellae in right valve, which receive between them the anterior lateral tooth of the left valve. Pallial sinus varying widely within the limits of the genus, angular and sharply defined to almost obsolete. Inner margins of valves entire.

The group is first recognized in the Eocene; since that time, it has formed a fairly conspicuous and widely distributed factor in the molluscan faunas of the warmer seas.

Subgenus *Agriopoma* Dall

1902. *Agriopoma* DALL, U. S. Nat. Mus., Proc., vol. 24, p. 509.

TYPE, BY MONOTYPY: *Cytherea texasiana* Dall. Recent in the Gulf of Mexico.

The subgenus as separated by Dall is characterized by the heavy chalky shell, the less involute umbones, and especially by the deep and angular pallial sinus.

*Callocardia* (*Agriopoma*?) sp. cf. *C. pteleina* Gardner

(Plate 5, figures 7, 12, 13)

Exteriors suggesting *Callocardia pteleina* Gardner pl. 4, fig. 6, (Univ. Texas Bull. 3301, p. 183, pl. 17, fig. 3; pl. 19, figs. 1-3, 1935) from the lower Midway of south Texas, but larger and possibly more produced anteriorly, were collected in the lower Eocene, probably the upper Midway of the San Juan section, U.S.G.S. sta. 13462 (E-18). Associated with the larger forms (such as U. S. Nat. Mus. 495004) are much smaller, also concentrically lirated bivalves of the same general outline (U. S. Nat. Mus. 494977). These may be juveniles, although their appearance does not suggest immaturity.

*Callocardia* (*Agriopoma*) *amichel* Gardner, n. sp.

(Plate 9, figures 26-29, 31)

1857. *Cytherea Nuttali* CONRAD, in EMORY, U. S. Mex. Boundary Survey Rept., vol. 1, pt. 2, p. 162, pl. 4, fig. 5.  
 Not *Cytherea Nuttali* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 1st ser., vol. 7, p. 149, 1834.  
 1891. *Cytherea Nuttalli* CONRAD. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc., p. 402.  
 1919. *Meretrix trigoniata* var. *bastropensis* HARRIS, Bull. Am. Paleontology, vol. 6, p. 148 (part), pl. 47, fig. 6.  
 1923. *Callocardia bastropensis* (Harris). GARDNER, U. S. Geol. Survey, Prof. Paper 131-D, p. 95 (name only).  
 1924. *Callocardia bastropensis* Harris. DEUSSEN, U. S. Geol. Survey, Prof. Paper 126, p. 65 (part).  
 1931. *Meretrix trigoniata* Lea var. *bastropensis* Harris. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 104.

"... 2d, when preserved in firm calcareous sandstone.—Shell comparatively larger, thicker, with less plainly marked concentric striae on the umbones and much coarser lines or rugae near the anterior, basal and posterior margins (fig. 6). . . .

"This species is generally characterized by the broad, circular form of its posterior margin. The form together with the character of the concentric striae or rugae on the larger specimens found along the Rio Grande will serve to differentiate it from *trigoniata* or *nuttali*. In the last mentioned species the rugae are sharp or lamellar, while in *bastropensis* they are rounded, or semicylindrical. The pallial sinus deeper than in *trigoniata*.

"Type specimens.—Pl. 47; . . . fig. 6, No. 1721, Sta. 11. Texas State Museum. Now at the Univ. of Texas.

"Geological Horizon.—St. Maurice Eocene." Harris, 1919.

The *Callocardia* included by Harris under *bastropensis*, "2d aspect," is one of the most abundant and generally distributed species of the lower Laredo Mollusca of the Rio Grande Embayment. The differences between this and the species from the Colorado River, the "1st aspect," seem sufficiently important to be recognized in the taxonomy. Harris apparently considered the specimens that he



illustrated in figures 4 and 6 as cotypes, the one of his first race, the other of his second. Unfortunately, he has reversed his localities, for station 37, the locus of the specimen represented in figure 4, is "Rio Grande, 15 miles below Carrizo," and station 11, the locus of the original of figure 6, is "Devil's Eye, Colorado River, Bastrop County." The name *bastropensis* is retained for the specimen illustrated by figure 4 of plate 47, Bulletin of American Paleontology, vol. 6, 1919, and it is here designated the lectotype. The type locality is probably station 11, Devil's Eye, Colorado River, Bastrop County, in the Weches member of the Mount Selman formation. The name *Callocardia amichel* is proposed for the group of forms represented by the original of figure 6 (Harris, 1919), though another shell is selected as the type. The specific name is that used by Pineda, an adventurer of the time of Cortez, who touched upon the mainland of the western Gulf of Mexico and called it "Amichel." *Callocardia amichel* is characterized by the smooth arc of the ventral half of the valve; by the short broadly rounded posterior end; and by the rather crude concentric sculpture, most pronounced toward the posterior lateral and ventral margins. *Callocardia astartoides* Gardner occasionally exhibits a similar outline, but the concentric sculpture is more uniform over the disk, and there is usually some trace of a radial lineation. The characters of the interior of *Callocardia amichel* are not accessible.

**DIMENSIONS OF HOLOTYPE (LOCKED DOUBLE VALVES):** Height, 32 millimeters; width, 34 millimeters; convexity of double valves, 21 millimeters. **Paratype (locked double valves):** Height, 27 millimeters; width, 26.5 millimeters; convexity of double valves (estimated), 20.5 millimeters.

**HOLOTYPE, LOCKED DOUBLE VALVES:** U. S. Nat. Mus. 496021; paratype, U. S. Nat. Mus. 559290.

**TYPE LOCALITY OF HOLOTYPE AND PARATYPE:** U. S. Geol. Survey sta. 13981 (H-6). 2890 meters S. 3° E. from La Presa well No. 1, Mier, Tamaulipas. Middle part of Laredo formation.

The figured specimen, U. S. Nat. Mus. 496020 from U.S.G.S. sta. 13557 (H-10), is 29.0 millimeters high and of an almost equal width.

*Callocardia amichel* is represented in most of our collections from the Laredo formation of Webb and Zapata counties. In Mexico, it is less widely distributed and not so abundant, but it is far from rare.

Small ovate-trigonal valves with the umbonal characters and surface sculpture of *Callocardia amichel* are abundant at U.S.G.S. stas. 13772 (G-3) and 13977 (H-5). They may represent adolescent *amichel* but they do not seem immature and are not associated with larger forms. Their status for the time being must remain undetermined.

**DISTRIBUTION:** Laredo formation: middle Laredo, U.S.G.S. sta. 13936 (G-3); U.S.G.S. sta. 13480 (F-4); U.S.G.S. sta. 13790 (G-4); U.S.G.S. sta. 13981 (H-6); U.S.G.S. sta. 13990 (H-9); U.S.G.S. sta. 13557 (H-10); U.S.G.S. sta. 13566 (H-12); U.S.G.S. sta. 13569 (H-12).

### *Callocardia (Agriopoma) sp.*

A relatively high and highly inflated species of *Callocardia* is imperfectly represented in the upper part of the Mount Selman formation at U.S.G.S. sta. 13632 (L-24), 2100 meters east of Rancho Presa Nueva, Presa Nueva, Santa Ana, Nuevo León. The general outline recalls *Callocardia bastropensis* (Harris), but the inflation is greater, and the umbones more inrolled. It resembles *Callocardia texacola* in the fullness of the beaks but is higher and less produced posteriorly. The species is probably new and may perhaps be duplicated in some of the poorly preserved material from south Texas.

### *Callocardia (Agriopoma) tornadonis* (Harris)

(Plate 9, figures 24, 25)

- ?1915. *Cytherea texacola* var. *tornadonis* Harris, Ms. DUMBLE, Geol. Soc. Am., Bull., vol. 26, p. 453 (nomen nudum).  
 ?1915. *Cytherea tornadonis* Har.?. DUMBLE, Geol. Soc. Am., Bull., vol. 26, p. 463 (nomen nudum).  
 1919. *Meretrix texacola* var. *tornadonis* HARRIS, Bull. Am. Paleontology, vol. 6, p. 142, pl. 45, figs. 2, 3.

"In Texas, we formerly designated the smaller, longer forms as var. *tornadonis*." Harris, 1919.

This characterization follows the description and discussion of *Meretrix texacola* Harris, 1919. No mention is made of a varietal form *tornadonis* in the original *Meretrix texacola* Harris, 1895, and



the name as it is used in Dumble's check lists is a *nomen nudum*. The transversely ovate trigonal Callocardias with inflated, incurved umbones that in Texas are included under *Meretrix texacola*, s. l., of Harris fall into two groups: the large, relatively high shells, restricted apparently to the Weches member of the Mount Selman formation of east and central Texas; and the smaller, relatively lower forms which are most common at a slightly higher horizon. Much of the material is imperfect or immature, and when properly discriminated these species may prove to be of stratigraphic significance. None of the Mexican individuals are as large as those from East Texas. There is a considerable range of variation in relative dimensions, but in comparison with the Weches forms the shells are not so large, less heavy, and more strongly sculptured toward the ventral margins. The figured specimen is a little smaller than the average for Mexico, and perhaps a little more elongated transversely. The anterior extremity is produced and rather sharply rounded, the posterior obscurely truncate. The curvature of the ventral margin is broad, the inflation over the disk rather marked; the umbones are full to their tips, which are curved inward and forward and fall in advance of the median vertical. The lunule is defined by an incised line which intercepts the growth lines, but their direction is unchanged, and their strength undiminished within the lunular area. The escutcheon is not defined. The species is abundant in the lower and middle Laredo formation, but in our collections it always occurs as double valves. This mode of preservation bespeaks an effective dentition and burial in quiet waters.

DIMENSIONS OF FIGURED SPECIMEN: Height, 23 millimeters; width, 29 millimeters; diameter, 18 millimeters.

FIGURED SPECIMEN (LOCKED DOUBLE VALVES): U. S. Nat. Mus. 496038 from U.S.G.S. sta. 13570, General Bravo, Carlos Cantú, Nuevo León. Middle part of the Laredo formation. Molds recalling *Callocardia tornadonis* in profile but much less inflated occur at a number of localities in the lower Laredo. In some the beaks tend to be subcentral, and the curvature of the anterior extremity broader so that the form becomes intermediate in outline and relative dimensions between *Callocardia tornadonis* and *Callocardia amichel*. Such forms occur at U.S.G.S. stas. 13570 (H-12), 13547 (I-14), 13556 (I-14), and 13970 (I-19).

The fact that these forms occur commonly at the same localities with *Callocardia tornadonis* makes it seem improbable that the variant is of taxonomic significance.

DISTRIBUTION: Laredo formation: lower Laredo, U.S.G.S. sta. 13595 (H-15); U.S.G.S. sta. 13971 (I-20); middle Laredo, U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13547 (I-14); U.S.G.S. sta. 13556 (I-14); U.S.G.S. sta. 13553 (H-15).

*Callocardia (Agriopoma) sp.*

(Plate 7, figures 16, 20)

Another allied form of uncertain position is represented by a pair of locked valves (U. S. Nat. Mus. 496348). They are more than double the dimensions of the usual *Callocardia tornadonis* of Nuevo León, less inflated, and less produced anteriorly. The valves are 57 millimeters high; the width is 65 millimeters; the convexity, 38 millimeters. They come from the middle part of the Laredo formation at U.S.G.S. sta. 13569 (H-12), General Bravo, Carlos Cantú, Nuevo León. The general outline can be matched in specimens included under *C. tornadonis*. The generalized characters of the shell surface are the same in both. The characters of the hinge and of the musculature are inaccessible in the locked valves. The specimen cited from the middle Laredo at U.S.G.S. sta. 13547 (I-14) has a comparable height (55 millimeters) but is only about 57 millimeters wide.

*Callocardia (Agriopoma) sp.*

Poorly preserved material from the middle part of the Laredo formation at U.S.G.S. sta. 13547 (I-14) indicates a species comparable in outline and dimensions to *Callocardia poulsoni* (Conrad) but decidedly less inflated and with a less pronounced inrolling of the beaks. The height of the Mexican shell is about 55 millimeters, the width slightly greater. The same species is indicated by poorly preserved material from southeast of Cotulla in La Salle County, Texas.



*Callocardia (Agriopoma) calceola* Gardner

(Plate 11, figures 10, 11)

1936. *Callocardia (Agriopoma) calceola* GARDNER, Fla. Dept. Conservation, Geol. Bull. 14, p. 30, pl. 7, figs. 3, 4.

Shell thin for the group, a deep, transversely elongated scoop, broadly rounded behind, narrow and snoutlike in front. Umbones low but full, the tips bent forward and inward, falling near the beginning of the anterior third of the shell. Lunule long and rather wide, defined by an incised line. Escutcheon not delimited but suggested by the flattening of the shell and the evanescence of the sculpture. Outer surface crowded with raised concentric threads not uniformly continuous from the anterior to the posterior margin but tending to bifurcate and reunite. Ligament deeply inset, produced for about half the length of the posterior dorsal margin. Hinge normal; only that of the left valve known. Hinge plate thin, sinuous. Anterior and medial cardinals coalescent, obliquely divergent beneath the tips of the umbones; posterior cardinal laminar, produced; anterior lateral, a dentate process near the anterior extremity of the hinge plate. Muscle scars large but inconspicuous, particularly the posterior. Pallial line distinct, rather close to the margin. Pallial sinus very broad and shallow, the axis directed toward the tips of the umbones. Inner margins simple.

DIMENSIONS: Height, 40 millimeters; width, 54 millimeters; thickness of single valve, 16 millimeters.

HOLOTYPE, A LEFT VALVE: U. S. Nat. Mus. 372888.

TYPE LOCALITY: No. 10603, gully south of the road and east of the bridge over White's Creek, on road from Eucheeanna to Knox Hill, 6.7 miles south of Argyle, 1.7 miles southeast of Eucheeanna, Walton County, Florida.

*Callocardia calceola* differs from all other Alum Bluff *Callocardias* in the greater dimensions and relatively greater width but resembles in general outline and dimensions the type of the subgenus, *Callocardia (Agriopoma) texasiana* Dall, a Recent species in the western Gulf of Mexico. The Recent species, however, is broader and less produced anteriorly, the muscle scars are smaller, and the pallial sinus is much deeper and acutely pointed.

A mold from Tamaulipas cannot be determined with assurance, but there are no characters preserved by which it can be separated from the Florida species. The similarity to the Recent Gulf species may indicate a continuance of the race in the Gulf waters since middle Miocene time.

DISTRIBUTION: Guajalote formation: ?U.S.G.S. sta. 13588 (W-30).

*Callocardia (Agriopoma) sp.*

Molds with a few impressions of fine concentric surface sculpture are not rare in the Guajalote formation in the vicinity of San Fernando, U.S.G.S. sta. 13455 (W-29). They suggest several species but are not certainly identical with any of them. They are smaller and less narrow and less produced in front than *Callocardia calceola* Gardner, from White's Creek, Florida. *Callocardia (Agriopoma) gatunensis* Dall is shorter and broader in front. *Callocardia prosayana* Gardner, from the Shoal River formation of Florida, is also shorter than the larger specimens, though some of the smaller and possibly immature individuals are equally short and high. Possibly more than one species is represented.

*Incertae sedis*

(Plate 9, figures 21, 22)

Shell small and moderately thick, transversely ovate-trigonal, moderately inflated. Lateral extremities broadly rounded, the posterior produced, the base line strongly arcuate, the dorsal margins somewhat oblique. Umbones a little in advance of the middle, with small pointed incurved and prosogyrate tips. Lunule large, defined by a feebly incised line. No escutcheon nor defined posterior area. Outer surface smooth except for growth striae. Ligament short, deeply inset. Valves locked and filled with an indurated matrix so that the characters of the interior are not accessible. Inner margins crenulated.



DIMENSIONS OF FIGURED SPECIMEN (DOUBLE VALVES): Height, 12.0 millimeters; width, 15.5 millimeters; convexity of double valves, 8.0 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 496441.

LOCALITY OF FIGURED SPECIMEN: U.S.G.S. sta. 13966 (J-7), 2 kilometers S. 41° W. from Rancho Las Garcias, Mier, Tamaulipas. Yegua formation.

The double valves have the aspect of a *Callocardia*, but the shell is too small, and the denticulation along the inner edge of the valve is a character unknown in *Callocardia s. s.* The crenae are determined by an exceedingly faint and very fine subcutaneous radial threading.

This may be among the species abundantly represented by small molds of double valves in Mexico at U.S.G.S. sta. 13495 (H-3) and, in Texas, directly north of the gate of the Guerra Ranch, three fourths of a mile below the Zapata-Starr County line on the Laredo Highway. In the Mier sector the molds occur in a 6-inch white marl underlain by red clay and overlain by a massive cross-bedded sandstone. In Starr County the stratigraphic relationships are similar. The shell is rarely retained on the molds recovered either from the Mier or the Starr County outcrops, and the hinge is unknown. The molds retain, however, the scar of a short linguiform sinus with its axis directed obliquely upward toward the lunule.

DISTRIBUTION: Yegua formation: ?U.S.G.S. sta. 13495 (H-3); U.S.G.S. sta. 13966 (J-7).

*Callocardia (Agriopoma) sp. cf. C. (A.) securiformis* (Conrad)

Synonymy and description of *Callocardia (Agriopoma) securiformis* (Conrad):

- 1865. *Dione securiformis* CONRAD, Am. Jour. Conchology, vol. 1, p. 137, pl. 10, fig. 1.
- 1866. *Dione securiformis* CONRAD, Smith. Misc. Coll., vol. 7, no. 200, p. 24.
- 1894. *Cytherea securiformis* CONRAD. HARRIS, Geol. Survey Ark., Ann. Rept., vol. 2, p. 153.
- 1919. *Meretrix securiformis* HARRIS, Bull. Am. Paleontology, vol. 6, p. 142.

"Subcordate, ventricose, with concentric recurved ribs; anterior margin acutely rounded; posterior extremity subtruncated; lunule cordate, defined by a slightly impressed line; right valve-cardinal teeth approximate, curved, direct." Conrad, 1865.

TYPE LOCALITY: Garlands Creek, 3 miles east of Shubuta (by error, described from Enterprise), Mississippi.

The specimens from the Jackson of Mexico do not exhibit the prominent inrolled beaks that characterize the Mississippi form and are probably not conspecific. They differ, too, in the rather stronger umbonal sculpture but are similar to the topotypes in general outline, thickness of the shell, and character of the adult sculpture. The Mexican material is not well preserved and does not justify description. One of the larger specimens is about 35 millimeters high and 45 millimeters wide.

DISTRIBUTION: Jackson formation: lower or middle Jackson, U.S.G.S. sta. 13504 (M-8); upper Jackson, U.S.G.S. sta. 13598 (L-11).

*Incertae sedis*

Molds and locked valves of small pelecypods are extremely abundant in a 6-inch white marl near the top of a highly colored clay series of the Yegua at U.S.G.S. sta. 13495 (H-3), 2620 meters N. 37½° E. of Mier Church, and the same forms may be present at U.S.G.S. sta. 13966 (J-7), 2 kilometers S. 41° W. from Rancho Las Garcias, Mier, Tamaulipas. The clays probably correspond in position to those beneath the scarp-forming sandstone at Loma Blanca in Zapata County, Texas. Several species and possibly several genera are represented among the bivalves, but the hinges are not accessible, and even generic determinations are impossible. A number of individuals exhibit the outline and characteristic radial lineation of *Nucula mauricensis*, but they retain no trace of a taxodont dentition. Other forms, also radially lineated, are plump and subcircular, suggesting in outline and sculpture *Phacoides (Parvilucina)*, but, on the molds which have preserved the adductor and pallial scars, the anterior adductor is not elongated, and there is a well-defined sinus. Possibly *Callocardia* and other venerids are represented. Associated with the bivalves are a few gastropods, probably cerites, abundant slightly higher in the same clay series. The bivalve fauna presents clearly the aspect of a marine assemblage. The shell substance when preserved is fairly thick and heavy, many of the shells are radially lineated, the growth laminae may be conspicuously sharp and regular, and many individ-



uals retain the scar of a short, sharply defined, pallial sinus. Undoubtedly, the water was shallow, and the succeeding gastropod faunule may indicate a further retreat of the sea sufficiently pronounced to permit the invasion of a brackish-water fauna.

*Incertae sedis*

Small transversely ovate bivalves that look like venerids are abundant near La Llorona dam at U.S.G.S. stas. 13732 and 13572 (T-16) possibly in the lower Miocene. They are about 7.5 millimeters high and 8.5 millimeters wide and are sharply and regularly lirated. The hinge is not accessible.

*Incertae sedis*

(Plate 5, figure 14)

Rather small, high, ovate-trigonal bivalves with full, rounded, slightly anterior and prosogyrate beaks are fairly common below the tilted shales in the San Juan section. The anterior extremity is strongly rounded in front of the lunular depression, the escutcheon is obscurely or not at all defined, the posterior lateral margin, obtusely truncate, and the base feebly arcuate. A concentric wrinkling increasingly strong toward the ventral margin is developed over the greater part of the shell. The hinge is not accessible, and the pallial characters are dubious. The inner ventral margin is simple.

DIMENSIONS OF FIGURED SPECIMEN: Height, 10.5 millimeters; width, 11.5 millimeters.

FIGURED SPECIMEN, A RIGHT VALVE: U. S. Nat. Mus. 495005.

LOCALITY: U.S.G.S. sta. 13462 (E-18), downstream section of tilted shales on Rio San Juan, below the series of evenly stratified shales, Nuevo León. Lower part of the Eocene, probably the upper Midway formation.

The material is inadequate for even a generic determination, but the outline and surface sculpture are characteristic and may be of stratigraphic significance.

*Incertae sedis*

Small transversely ovate bivalves, probably venerids, with a strong cord-like concentric sculpture pack the sandy gray limestones in the upper part of the Indio section in Arroyo San Antonio at U.S.G.S. sta. 13678 (F-9). The shells are moderately inflated, the umbones anterior and prosogyrate. The lunule is rather narrow, unsculptured, but defined by an incised line. The escutcheon is linear lanceolate and less sharply defined than the lunule. The rounded concentric ribs number 25 to 30 and are strong and regular in elevation and spacing. There is also a suggestion of a faint *Chione*-like radial lineation on the dorsal surface of the ribs. The hinge is not accessible, nor are the characters of the muscle and pallial scars known.

DIMENSIONS OF LARGEST RIGHT VALVE: Height, 10.0 millimeters; width, 12.5 millimeters. This valve is relatively a little lower than the average. The species is sufficiently well characterized by the strong and regular concentric cording so that it should be recognizable even though a generic determination cannot be made.

Genus *Clementia* Gray

- 1840. *Clementia* GRAY, Synopsis of the contents of the British Museum, 42d ed., p. 149 (nomen nudum).
- 1842. *Clementia* GRAY, Synopsis of the contents of the British Museum, 44th ed., p. 75. "The *Tapes* and *Venerupes* have oblong shells with very compressed teeth, and the *Clementia* are like the latter but are very thin and have a cavity in the margin before and behind the teeth." (Genus without species).
- 1847. *Clementia* GRAY, Zool. Soc. London, Proc., pt. 15, p. 184.

TYPE, BY ORIGINAL DESIGNATION, 1847: *Venus papyracea* Gray. Recent off the southeastern coast of Australia.

The genus has been exhaustively monographed by Woodring (U. S. Geol. Survey, Prof. Paper 147, pp. 25-42, 1926).

*Clementia* (*Clementia*) is recognized in the Eocene of Colombia and Peru, the Oligocene of Peru and Puerto Rico, the Miocene of the mid-Americas and South America to Brazil, but in the Recent faunas only in the Indo-Pacific.



Subgenus *Egesta* Conrad

1845. *Egesta* CONRAD, Fossils of the Tertiary formations of the United States, p. 70.  
 1926. *Egesta* Conrad. WOODRING, U. S. Geol. Survey, Prof. Paper 147, pp. 36-37.

TYPE, BY MONOTYPY; *Venus inoceriformis* Wagner, Acad. Nat. Sci. Philadelphia, Jour. 1st ser., vol. 8, p. 51, pl. 1, fig. 1, 1839. Middle Miocene, Maryland.

"Shell relatively large, thin or heavy, inequilateral, upper posterior slope generally flattened or slightly concave, producing a truncate posterior end. Lunular area moderately or deeply depressed, otherwise poorly defined. Escutcheon poorly defined. Sculpture *Clementia*-like, consisting of coarse concentric waves and fine concentric threads, both of which may be replaced on the ventral part of the shell by growth lines. Resilium groove long, wide, and deep. Hinge of right valve consisting of a slender anterior cardinal, a heavier middle cardinal, and a slender, deeply bifid posterior cardinal; hinge of left valve consisting of a slender anterior cardinal, a heavy middle cardinal, and a very thin posterior cardinal. Pallial sinus narrow, deep, ascending, slightly tapering to an asymmetrically U-shaped apex.

"Conrad casually gave the name *Egesta*, as a subgenus of *Venus*, to *Venus inoceriformis* and promptly forgot it. Apparently the name has been overlooked. It is here proposed to use *Egesta* as a subgeneric name embracing several American fossils and two living species—*Clementia solida* Dall, from the Gulf of California, and *Clementia vatheliti* Mabilie, from waters off Japan and Chosen.

"The larger and heavier shell, flattened or concave upper posterior slope, accompanying truncation of the posterior end, longer and deeper resilium groove, heavier hinge, and narrower pallial sinus separate *Egesta* from *Clementia* s.s." Woodring, 1926.

*Clementia (Egesta)* sp. cf. *C. (E.) grayi* Dall

Synonymy and description of *Clementia (Egesta) grayi* Dall:

1900. *Clementia grayi* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 5, p. 1193, pl. 37, fig. 12.  
 1903. *Clementia grayi* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 6, p. 1236.  
 1917. *Clementia* cf. *dariena* Conrad. DICKERSON AND KEW, Calif. Acad. Sci., Proc., 4th ser., vol. 7, No. 5, table opposite p. 128.  
 1926. *Clementia grayi* Dall. GARDNER, U. S. Geol. Survey, Prof. Paper 142, p. 154, pl. 24, fig. 6.  
 1926. *Clementia (Egesta) grayi* Dall. WOODRING, U. S. Geol. Survey, Prof. Paper 147, p. 37, pl. 15, fig. 4.

"Shell thin, convex, rude, concentrically coarsely and irregularly striated, near the beaks concentrically undulated, without lunule or escutcheon; internal margins smooth, adductor scars large, pallial line with a long, narrow, acute sinus extending forward more than two-thirds the way from the posterior to the anterior adductor; cardinal teeth entire, the middle cardinal strongest. Height 55, length 63, diameter 32 millimeters." Dall, 1903.

TYPE: U. S. Nat. Mus. 107381.

TYPE LOCALITY: U.S.G.S. sta. 2646, Oak Grove, Yellow River, Okaloosa County, Florida.

The casts from Sopchoppy and some of the specimens from the Shoal River beds have the typical transversely ovate, posteriorly truncate outline, but there are others from near Mossyhead, Walton County, Florida, which seem to be relatively higher and less elongated transversely.

The specimens from northeastern Mexico from the Guajalote formation at U.S.G.S. sta. 13455 (W-29) and U.S.G.S. sta. 13588 (W-30) are similar to the higher, more ovate-trigonal casts from the Shoal River formation near Mossyhead.

Genus *Pitar* Römer

1857. *Pitar* RÖMER, EDUARD, Kritische Untersuchung der Arten des Molluskengeschlechts *Venus* bei Linné und Gmelin, p. 15.

TYPE, BY MONOTYPY: *Venus tumens* Gmelin. Recent off the coast of Senegal and in the Gulf of Guinea.

Shell of moderate dimensions, transversely ovate-trigonal, rather thin and inflated. Umbones full, the tips turned inward and forward in advance of the median line. Lunule elongate cordate, slightly wider in the right valve than in the left, defined by a feebly incised line. Escutcheon lanceolate, slightly wider in the left valve than in the right, defined only by the contour of the shell and the change in the direction of the growth lines. Sculpture concentric, more or less incremental. Liga-



ment marginal, inset, extending about half the length of the posterior dorsal margin. Hinge plate rather light, the dentition delicate. In the right valve, a short laminar anterior cardinal and, with a slight ventral offset, a heavier medial cardinal, their opposing faces flattened, proximate, and almost vertical; the posterior right cardinal obliquely produced parallel to the hinge line; a deep anterior lateral socket with margins modified for clasping, developed close to the cardinals. In the left valve, a very thin and almost vertical anterior cardinal, a short trigonal medial cardinal, and an obliquely produced posterior cardinal partially fused with the ligament nymph; anterior lateral short but heavy and prominent. Anterior and posterior adductor scars distinct, not very large. Pallial line distant from the margin. Pallial sinus deep, the apex acute and dorsally directed.

The restricted genus is not represented in the Tertiary of the western Gulf. Most of the recent species are tropical, many of them from the Indo-Pacific.

#### Subgenus *Hysteroconcha* Fischer

1887. *Hysteroconcha* FISCHER, Manuel de conchyliologie, p. 1079.

TYPE, BY MONOTYPY: *Venus dione* Linnaeus. Recent in the West Indies.

The subgenus is heavier and less inflated than *Pitar*, s. s. The lunule is shorter and defined by the absence of sculpture as well as by the incised line. The escutcheon is much more distinct than in *Pitar*, s. s., and is placed within a smooth area outlined by a flattening of the shell and by the sculpture pattern. Both the true and the false escutcheon are included within a posterior area sharply defined in the subgenotype by the spinose processes developed on alternating or on every third of the sharp regular and evenly spaced concentric laminae. A secondary series of spinose processes is developed along the margin of the false escutcheon in the umbonal area, but they become obsolete away from the umbones. The laminae are flattened and irregular behind the primary spines and on the false escutcheon are partially and on the true escutcheon completely obsolete. The crest of the ligament nymph is granulated. The dentition differs from that of *Pitar*, s. s., in that the right posterior cardinal is bifid. The pallial line is less distant from the margin, and the sinus is broader and less angular.

*Pitar*, s. s., is for the most part Indo-Pacific in distribution, but *Hysteroconcha* is characteristic of the West Indies and the Gulf of Mexico.

#### Section *Lamelliconcha* Dall

1902. *Lamelliconcha* DALL, U. S. Nat. Mus., Proc., vol. 26, p. 354.

TYPE BY ORIGINAL DESIGNATION AND MONOTYPY: *Cytherea concinna* Sowerby. Recent on the West Coast from Magdalena Bay to Ecuador and Peru.

"Shell trigonal, subcompressed, concentrically ribbed or laminate without spines; the edges of the nymphs smooth; otherwise like *Hysteroconcha*.

"Tropical seas, especially in America." Dall, 1902.

#### *Pitar (Hysteroconcha) mendezensis* Gardner, n. sp.

(Plate 11, figures 5, 8)

Shell of moderate dimensions and convexity, ovate-trigonal. Umbones narrow, fairly prominent, slightly posterior, prosogyrate. Lunule relatively large, defined by a deeply incised linear groove. No escutcheon. Posterior dorsal and lateral margins an unbroken arc merging smoothly into the almost horizontal base. Anterior lateral margin broken, a rather sharp curvature indicated by the growth lines. Outer surface concentrically lirate; resting stages conspicuous. Ligament marginal, inset in a groove which extends to the extremity of the narrow hinge plate. Three cardinals in the right valve, the anterior and medial cardinals thin, laminar, with flattened and closely proximate faces, posterior right cardinal produced and deeply bifid; a deep pit near the cardinals for the reception of the small, high, anterior lateral tooth; posterior dorsal margin grooved through almost its entire length to receive the beveled margin of the left valve. Pallial line and sinus obscure but traceable, the sinus short, deeply U-shaped, and obliquely ascending. Inner margins simple.



DIMENSIONS OF HOLOTYPE: Height, 16 millimeters; width, 18 millimeters.

HOLOTYPE, A RIGHT VALVE: U. S. Nat. Mus. 495051.

TYPE LOCALITY: U.S.G.S. sta. 13581 (P-25). Upper Oligocene sandstone.

The shell has the general form and dimensions of *Pitaria harrisi* Maury from the Chipola formation of Florida, but it lacks the heavy concentric ribbing of the Floridian shell. The type is unique.

#### Genus *Chione* Von Mühlfeld

1811. *Chione* MEGERLE VON MÜHLFELD, Entwurf eines neuen System's der Schalthiergehäuse, Mag. Gesell. naturf. Freunde zu Berlin, Jahrg. 5, p. 51.

TYPE, BY SUBSEQUENT DESIGNATION (GRAY, Zool. Soc. London, Proc., pt. 15, p. 183, 1847): *Venus dysera* Chemnitz = *Venus cancellata* Linnaeus. Recent from North Carolina to Brazil.

*Chione* includes the solid trigonal venerids of medium size and convexity characterized most obviously by strong, often crude concentric ribs or lamellae, with or without free upturned margins. A radial sculpture is indicated in the fluting of the free edges of the lamellae and in a radial grooving, in some groups restricted to the ventral surfaces of the concentric ribs or in groups with adnate lamellae cancellating the disk. The lunule and escutcheon are sharply set off by both the sculpture and the contouring of the shell. The ligament is marginal and deeply inset behind the beaks. There are 3 cardinals radiating fanlike in each valve, the medial and posterior cardinals in many groups grooved or bifid. True laterals are not developed. The muscle scars and the pallial line are distinct; the sinus, shallow and trigonal. The inner anterior and ventral margins are strongly crenate.

True *Chione* has not been certainly recognized in the southeastern United States below the Chickasawhay formation. From that level on *Chione* rapidly increases in prominence and in the upper lower and in the middle Miocene of the mid-Americas is ubiquitous and exceedingly abundant.

#### Subgenus *Chione* s. s.

1811. *Chione* MEGERLE VON MÜHLFELD, Entwurf eines neuen System's der Schalthiergehäuse, Mag. Gesell. naturf. Freunde zu Berlin, Jahrg. 5, p. 51.

TYPE, BY SUBSEQUENT DESIGNATION (GRAY, Zool. Soc. London, Proc., pt. 15, p. 183, 1847): *Venus dysera* Chemnitz = *Venus cancellata* Linnaeus. Recent from North Carolina to Brazil.

*Chione* (*Chione*) is characterized by a sculpture of regularly spaced, free-edged, concentric lamellae superimposed upon a radially lirated surface. The lamellae are commonly frilled in line with the radial lirations, and the inner margins of the valves are crenate.

#### *Chione* (*Chione*) sp. cf. *C. (C.) spenceri* Cooke

Description of *Chione* (*Chione*) *spenceri* Cooke:

1919. *Chione spenceri* COOKE, Carnegie Inst. Washington Pub. 291, p. 150, pl. 15, figs. 1a, 1b.

"Shell ovate, moderately convex, with low, prosogyrate beaks and a sharply defined, lozenge-shaped lunule with imbricating growth-lamellae; escutcheon lanceolate, flat or slightly concave, and with fine growth-lines; radial sculpture of minute, close, low, rounded ridges becoming obsolete at the anterior and posterior ends; concentric sculpture of erect, evenly spaced lamellae, 24 on the type specimen, smooth on the dorsal surface and on the upper part of the ventral surface, but with a row of beads, contiguous to the radial ribbing, at the base of the ventral surface.

"Length, 26 mm.; height, 23 mm.; diameter of joined valves, 15.5 mm.

"Localities.—Antigua, Spencer (type); Willoughby Bay, Antigua, station 6881; Vaughan.

"Geologic horizon.—Oligocene.

"Type.—U. S. Nat. Mus. No. 163352." Cooke, 1919.

Specimens firmly embedded in indurated sandstone from the lower Oligocene at U.S.G.S. sta. 13523 (M-12) may be related to the West Indian form. They are too imperfectly preserved for positive identification but they apparently lack the radial lineation which characterizes *C. spenceri*.

#### *Chione* (*Chione*) sp. cf. *C. (C.) bainbridgensis* Dall

Poorly preserved specimens from the lower marine Oligocene at U.S.G.S. sta. 13505 (N-8) and U.S.G.S. sta. 13510 (M-11) resemble *Chione bainbridgensis* in the general sculpture pattern, but the radial lineation is less uniformly developed.



Subgenus *Chamelea* Mörch

1853. *Chamelea* MÖRCH, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra et Gadea, Comes de Yoldi, fasc. 2, p. 23.

TYPE, BY SUBSEQUENT DESIGNATION (BUCQUOY, DAUTZENBERG AND DOLLFUS, Mollusques marins du Roussillon, vol. 2, p. 355, 1893): *Venus gallina* Linnaeus. Recent in the Mediterranean.

*Chamelea* is characterized by the narrow close concentric lamellae and the absence of radial sculpture. The cardinals are entire.

*Chione (Chamelea) mississippiensis* (Conrad)

1848. *Cytherea mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 293.  
 1848. *Cytherea mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 123, pl. 13, fig. 16.  
 1866. *Chione mississippiensis* CONRAD, Smith. Misc. Col., no. 200, p. 28.  
 1903. *Chione mississippiensis* CONRAD. DALL, Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, p. 1300.  
 1927. *Venus mississippiensis* (Conrad). K. V. W. PALMER, Palaeontographica Americana, vol. 1, no. 5, p. 183.  
 1929. *Venus mississippiensis* (Conrad). K. V. W. PALMER, Palaeontographica Americana, pl. 35, figs. ?2, ?4, ?10; pl. 36, fig. 20.

"Subtriangular, ventricose, elevated, with prominent concentric acute ribs, rather distant, and with irregular intervals and fine intermediate lines; posterior margin somewhat curved; basal margin profoundly rounded; summits prominent; inner margin entire. Length  $1\frac{1}{4}$ . Height the same nearly. Rare." Conrad, 1848.

TYPE LOCALITY: Vicksburg, Mississippi.

There is some doubt about the identification of this species. It is a rare form and not well figured. Two left valves in the collections of the U. S. National Museum were referred by Cooke to Conrad's species after comparison with the types in Philadelphia, although he noted on the label of one valve that the concentric lamellae were more closely spaced than on the type of *C. mississippiensis*. The valves in question are rather heavy and ovate-trigonal. The smaller valve measures 19.7 millimeters in height by 21.5 millimeters in width by 6.0 millimeters in convexity. The moderately wide lunule is defined by a deeply incised line. The escutcheon extends the length of the dorsal margin and is sharply delimited by the angulation of the valve and the abrupt cessation of the concentric sculpture. The sculpture is obtuse and crudely cordate, the cords roughly formed and irregularly spaced, commonly with 2 or 3 striations on intervals between them. A *Chione*-like crenulation is discernible upon the ventral surface of a few of the cords, but its development seems fortuitous. The ligament and hinge characters are normal for the group; the adductor and pallial scars distinct but not deeply impressed, and the pallial sinus short and trigonal. The crenation along the inner ventral margins is very faint.

*Chione craspedonia* Dall, 1903, is similar in sculptural detail but seems to be more elongate transversely. A few valves identical with those determined as *C. mississippiensis* were recovered from the lower Oligocene sandstones outcropping at U.S.G.S. sta. 13511, near Rancho La Copa, Zacate, Nuevo León. Most of the venerids, however, characterized by an ovate-trigonal outline and a strong concentric sculpture, are more regularly cordate than *C. mississippiensis*, no intercostal striations have been observed, and the tendency toward a *Chione*-like crenation of the concentric ribs is stronger, particularly toward the ventral margin. Some individuals approach very closely to *Chione matutina* Gardner and may be identical with it, but the type of *matutina* is a smaller, thinner shell with a regular and laminar concentric sculpture.

*Chione (Chamelea?) matutina* Gardner, n. sp.

(Plate 10, figures 10, 12, 16)

Shell of only moderate dimensions but unusually heavy, transversely ovate-trigonal, moderately compressed. Umbones slightly anterior, full at their tips, which are curved inward and forward. Lunule rather wide, outlined by a clearly incised groove. Escutcheon linear, lanceolate, extending the length of the posterior dorsal margin. Lateral and ventral margins strongly bowed from the extremity of the lunule to the posterior dorsal margin. Surface decorations of strong, evenly spaced



lamellae, directed outward and feebly crenulated along the margins on the antero-ventral portion of the disk. Hinge of right valve only known; conspicuously heavy for the weight and size of the shell. Ligament deeply inset, the groove extending about half the length of the dorsal margin. Three cardinals radiating fanlike from beneath the tips of the umbones; hinge plate which supports them rather heavy and sinuous. Anterior right cardinal short, oblique, and sublaminar; medial cardinal heavier, deltoid, and nearly vertical; the posterior stout, produced, and obscurely bifid. Muscle scars distinct, fairly large. Pallial line remote from the margin; sinus short, broadly curved, its axis directed toward the umbones. Inner ventral and lateral margins finely crenate.

**DIMENSIONS OF HOLOTYPE:** Height, 12.5 millimeters; width, 13.7 millimeters; convexity of single valve, 3.7 millimeters. **Dimensions of paratypes:** Larger paratype, height, 14.3 millimeters; width, 15.5 millimeters; convexity of single valve, 4.0 millimeters. Smaller paratype, height, 13.5 millimeters width, 14.4 millimeters.

**TYPE MATERIAL:** Holotype, a right valve, U. S. Nat. Mus. 496457; paratypes (2), a right and a left valve, U. S. Nat. Mus. 496458.

**TYPE LOCALITY:** Holotype and paratypes, U.S.G.S. sta. 13505 (N-8), 21 kilometers S. 25°30' E. of Ciudad Camargo, Tamaulipas. Lower marine Oligocene sandstone.

The type of *Chione matutina* is smaller than *Chione mississippiensis*, and the concentric sculpture is not cordate but laminar. The paratypes are more heavily sculptured than the holotype, and possibly none of them are mature.

**DISTRIBUTION:** Lower marine Oligocene sandstone: U.S.G.S. sta. 13505 (N-8); ? U.S.G.S. sta. 13509 (M-11); ? U.S.G.S. sta. 13510 (M-11).

#### *Incertae sedis*

Abundant molds of a venerid, probably a *Chione*, possibly of the subgenus *Chamelea* Mörch, were recovered from the yellow limestone of the Guajalote formation at U.S.G.S. sta. 13586 (V-29), 11,500 meters N. 30° W. from San Fernando, Tamaulipas. The outline is that of a rather large *Chione*. The sculpture is a strong and even concentric ribbing apparently free from radial lineation. *Chamelea*, the section in which the sculpture is characterized by a similar want of radial lineation, has not been recorded from the Miocene, though it is well developed in the mid-American Oligocene, and the type species, *Venus gallina* Linnaeus, is Recent off European shores and in the Mediterranean.

#### *Incertae sedis*

Bivalves, possibly lucinoids, possibly venerids, are abundant in the Discocylinid zone of the Mount Selman formation at U.S.G.S. sta. 13628 (L-24), China, Nuevo León. They are moderately compressed subcircular or ovate-trigonal forms up to 20 millimeters high adorned with deep concentric grooves and flat interspaces about a millimeter wide on the central part of the disk. The outline suggests the venerids, the sculpture, the lucinoids.

#### *Incertae sedis*

Abundant small forms 5 to 10 millimeters in their greatest dimension are associated with *Lutetia texana* in the upper part of the Mount Selman formation, U.S.G.S. sta. 13627 (L-24), southeast of Rancho Presa Nueva, Santa Ana, China, Nuevo León. In the transversely ovate-trigonal outline and concentric ribbing, elegant in its clear definition and regularity, the species suggests a venerid. Only imperfect molds with an occasional bit of adherent shell have been recovered.

### Superfamily MYACEA

### Family CORBULIDAE

### Genus *Corbula* Bruguière

- 1798. *Corbula* BRUGUIÈRE, Tableau encyclopédique et méthodique des trois règnes de la nature, Vers, coquilles, mollusques, et polypiers, pl. 230, figs. 1a-4a-d; 5a-c (Figures only, no text.)
- 1799. *Corbula* LAMARCK, Prodrome d'une nouvelle classification des coquilles, Soc. hist. nat. Paris, Mém., p. 89 (No species cited but reference made to pl. 230 of Bruguière).
- 1801. *Corbula* LAMARCK, Système des animaux sans vertèbres, p. 137.



1811. *Aloidis* MEGERLE VON MÜHLFELD, Entwurf eines neuen System's der Shalthiergehäuse, Mag. Gesell. Naturf. Freunde Berlin, Jahrg. 5, p. 67. Type by monotypy: *Aloidis guineensis* Von Mühlfeld = *Corbula sulcata* Lamarck.

TYPE, BY SUBSEQUENT DESIGNATION (Schmidt, G. F., Versuch über die beste Einricht., etc., pp. 57, 177, Gotha, 1818): *Corbula sulcata* Lamarck. Recent off the coast of Senegal.

In earlier reports I have followed the type designation of Children, 1822, *Corbula nucleus* Lamarck = *Corbula gibba* (Olivi). *Corbula sulcata* Lamarck served as the type of the subgenus *Aloidis*. If Schmidt's designation must be accepted, and there seems to be no adequate reason for rejecting it, *Aloidis* Von Mühlfeld becomes an exact synonym of *Corbula*, s. s.

Topotypes in the Academy of Natural Sciences, Philadelphia, are 15 to 20 millimeters high and 25 millimeters wide. The posterior keel is very sharp and defined posteriorly by a deep sulcus which persists from the nepionic shell to the margin. Both valves are coarsely rugose, the sculpture on the right valve heavier than on the left. Radial sculpture is absent on the conch. The tips of the umbones are conspicuously capped by the nepionic valves which differ remarkably from the adult. They are nearly equivalve, compressed, acutely rostrate posteriorly, and similarly sculptured with concentric rugae that strengthen toward the ventral margin. The group typified by the large coarse Senagalese shell has no representation in East American waters, either in Tertiary or in Recent time.

#### Subgenus *Varicorbula* Grant and Gale

*Aloidis* of authors; not *Aloidis* Von Mühlfeld, 1811.

*Agina* of authors; not *Agina* Turton, 1822.

*Corbula* s.s. GARDNER, 1926; 1928; 1935; not *Corbula* (Bruguière) Lamarck s.s.

1931. *Varicorbula* GRANT AND GALE. San Diego Soc. Nat. Hist. Mem., vol. 1, p. 420 (footnote).

TYPE, BY ORIGINAL DESIGNATION: *Corbula gibba* (Olivi). Recent off the west coast of Europe and in the Mediterranean; Tertiary of southern Europe.

"In case a new name is needed for the *gibba* group, we propose *Varicorbula*, with *Corbula gibba* (Olivi) as figured by Bucquoy, Dautzenberg, and Dollfus for the type." Grant and Gale, 1931.

The species typified by *Corbula gibba* (Olivi) have been referred to *Aloidis* by a number of authors, but *C. sulcata*, the type of *Corbula*, s. s., is a more coarsely sculptured shell double the size of *C. gibba*; its prodissoconch is transversely elongate and strongly rostrate in contrast to the relatively high, smooth, and feebly or not at all rostrate prodissoconch of *C. gibba*. *Mya purpurea* Montagu, type by monotypy of *Agina* Turton, 1822, a name that has been used for the *gibba* group by Cossmann, Gray, and others, is a *Saxicava*. *Caestocorbula* Vincent, type by original designation, *Corbula henckeli* Nyst, is characterized by an accessory siphonal plate. *Varicorbula* is next in line, and it seems unfortunate that the name for so important a group should be introduced merely by a footnote.

Shell small, thick, ovate, more or less rostrate. Valves unequal, the left usually smaller and flatter. Umbones prominent, prosogyrate or erect, the right usually higher than the left. Surface sculpture variable, commonly discrepant on the two valves of the same individual; radial sculpture, if present, usually confined to the left valve. Hinge line of right valve fitted with a single prominent tooth in front of the resilial pit; lateral laminae absent. Left valve with a chondrophore and a deep cardinal socket. Adductor scars distinct. Pallial line indistinct, sinus feeble or obsolete. Gutter in right valve into which the edge of the left valve is fitted in the closed shell.

*Varicorbula* includes some of the most abundant and widespread species in the Tertiary faunas of the Gulf Province.

#### *Corbula* (*Varicorbula*) *texana* Gabb

(Plate 9, figures ?1, ?5)

1860. *Corbula texana* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 387, pl. 67, fig. 54.  
 1865. *Corbula texana* Gabb. CONRAD, Am. Jour. Conchology, vol. 1, p. 3.  
 1891. *Corbula Texana* Gabb. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, p. 401.  
 1896. *Corbula texana* Gabb. VAUGHAN, U. S. Geol. Survey, Bull. 142, p. 47.  
 1898. *Corbula* (*Aloidis*) *texana* Gabb. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 845.  
 1919. *Corbula texana* Gabb. HARRIS, Bull. Am. Paleontology, vol. 6, p. 190, pl. 57, figs. 24-28.  
 1931. *Corbula texana* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 103.



"Inflated, subtriangular, thick, umbones large; right valve marked by numerous large, transverse ribs; umbonal slope rather abrupt; basal margin regularly rounded; left valve?"

"Dimensions.—Length .3 in., width .38 in., depth of right valve .15 in.

"Common. I have seen numerous specimens of the right valve, but no left valves." Gabb, 1860.

HOLOTYPE AND SEVERAL PARATYPES: Acad. Nat. Sci. Philadelphia, 13262.

The type locality is not given and may have been either Wheelock or Caldwell County, Texas.

The fact that a species widespread and fairly common in the Western Gulf has no synonyms indicates a uniformity in its appearance. The shell is unusually thick, and the outline of the right valve trigonal. The much smaller left valve is rudely quadrate with an evenly rounded anterior end, an obliquely truncate posterior end, and a straight base. The curvature of the shell along the vertical axis is as strong as it is along the horizontal. The beaks are rather small, strongly incurved and flattened in the right valve, pointed and upstanding in the left. On the right valve there is a pronounced resting stage at the close of adolescent growth. The heavy adolescent shell which rests, in many specimens, at an angle of about 90° to the vertical axis of the shell is finely, sharply, and regularly sculptured concentrically. The pattern of the later adult shell is coarser and much less regular. The break in the sculpture pattern on the left valve is less obvious because the sculpture is crudely developed on both the young and the adult shell. There is no concentric corrugation on the left, only a few irregular growth wrinkles and, on most of the shells, a feeble radial rippling. Both valves are bicarinate; the primary keel is well defined but not acute, the secondary is close to the dorsal margin and rather obscure. The dentition is normal for the group and only moderately strong. The pallial line is faintly defined and deep. The gutter which parallels the margin of the right valve and into which the edge of the left is received in the closed shell is clearly incised. Both valves are exceptionally well characterized.

DIMENSIONS OF FIGURED SPECIMEN: Right valve: height, 8.8 millimeters; width, 11.5 millimeters. Left valve: height, 6.7 millimeters; width, 10.0 millimeters.

FIGURED SPECIMENS: Right valve, U. S. Nat. Mus. 495027 and left valve, U. S. Nat. Mus. 496270.

Locality of figured specimen, right valve, U.S.G.S. sta. 13634 (M-24), and left valve, U.S.G.S. sta. 13628 (L-24).

*Corbula texana* is restricted in its distribution, vertically and areally. In Texas, Stenzel reports it from both above and below the Moseley and the Little Brazos limestones. In northeastern Mexico it is restricted to a few localities near Presa Nueva, Santa Ana, Nuevo León, one of them directly below the *Ostrea lisbonensis* zone, the others above it. The determinations have been questioned only because of the imperfect preservation of the material. The characters retained are similar to those displayed by the examples from the lower Claiborne of Texas.

DISTRIBUTION: Mount Selman formation: U.S.G.S. sta. ?13626 (L-24); U.S.G.S. sta. ?13628 (L-24). Laredo formation: middle Laredo, U.S.G.S. sta. ?13634 (M-24); U.S.G.S. sta. ?13643 (M-25); U.S.G.S. sta. ?13645 (M-25).

### *Corbula (Varicorbula) smithvillensis* Harris

(Plate 9, figures 2-4, 7-9)

- 1891. *Corbula rugosa* Lamarck. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, p. 401. Not *Corbula rugosa* Lamarck, 1818.
- 1895. *Corbula aldrichi* Meyer var. *smithvillensis* HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 52, pl. 3, figs. 5, 5a.
- 1898. *Corbula (Cuneocorbula) gregorioi* Cossmann. DALL, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 843 (part). Not *Corbula gregorioi* Cossmann, 1893.
- 1919. *Corbula smithvillensis* HARRIS, Bull. Am. Paleontology, vol. 6, p. 188, pl. 57, figs. 10-17.
- 1931. *Corbula smithvillensis* Harris. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 103, 107.

"The variety is larger than the typical form, beak in the left valve more nearly central; right valve proportionally higher; radiating lines generally obsolete." Harris, 1895.

TYPE LOCALITY: Smithville, Bastrop County, Texas.

HOLOTYPE: No. 462, Paleontological Laboratory, University of Texas, Austin, Texas.



"The umbones of the valves in *smithvillensis* are generally smooth; the strong concentric liration begins medially or basally generally . . . . The type of *smithvillensis* was rather unusually large and smooth as published in the Proc. Phila. Acad. as noted above. Corrugations are apt to cover a greater portion of the shell. There is always something of an umbonal ridge, but in many Louisiana specimens it is not at all prominent. . . . "Harris, 1919.

Stenzel reports *Corbula smithvillensis* from above and below both the Moseley and the Little Brazos limestones. It is distinctly larger in and about the type locality at Smithville than it is in the stratigraphically higher beds at Moseleys Ferry. This difference should possibly be recognized in the taxonomy, but it is difficult to detect in any but a long series, and its value has not been established. *C. smithvillensis* is by far the most prolific member of the genus in central Texas, but at only a very few localities in Mexico does it approach in abundance its representation north of the Rio Grande. In the lower Laredo formation at U.S.G.S. sta. 13563 (H-12), 2800 meters S. 55° E. of Doctor Cos, Nuevo León, and at U.S.G.S. sta. 13558 (H-12) 2150 meters east of Doctor Cos, a 2- to 4-inch ferruginous layer is packed with *C. smithvillensis* of the same dimensions and aspect as those from Mosleys Ferry on the Brazos. Elsewhere, in the material recovered, the species has only a scattered distribution. A few of the individuals reach the dimensions of the topotypes, but for the most part they are similar to those at the localities cited.

Dimensions of figured specimens U. S. Nat. Mus. 496268 from U.S.G.S. sta. 13601 (H-16): Height, 6.2 millimeters; width, 8 millimeters; convexity of double valves, 5.5 millimeters; U. S. Nat. Mus. 496269 from U.S.G.S. sta. 13596 (H-15): Height 6 millimeters; width 7 millimeters; convexity of double valves, 6.4 millimeters. The second specimen has been distorted; the height measurement is therefore probably a little low, and the convexity a little high.

DISTRIBUTION: Mount Selman formation. ?U.S.G.S. sta. 13627 (L-24). Laredo formation: lower Laredo, U.S.G.S. sta. 13568 (G-11); ?U.S.G.S. sta. 13558 (H-12); ?U.S.G.S. sta. 13563 (H-12); U.S.G.S. sta. 13600 (H-15); U.S.G.S. sta. 13596 (H-15); ?U.S.G.S. sta. 13595 (H-15); U.S.G.S. sta. 13601 (H-16); ?U.S.G.S. sta. 13618 (H-17); U.S.G.S. sta. 13617 (H-18); U.S.G.S. sta. 13597 (I-18); ?U.S.G.S. sta. 13970 (I-19); U.S.G.S. sta. 13967 (J-20); U.S.G.S. sta. 13625 (J-20).

### *Corbula (Varicorbula) gregorioi* Cossmann?

(Plate 9, figures 11, 12)

Synonymy and description of *Corbula (Varicorbula) gregorioi* Cossmann:

- 1894. *Corbula compressa* Lea var. *gregorioi* COSSMANN, Annales géologie paléontologie, 12<sup>me</sup> livr., p. 6, pl. 1, figs. 4, 5.
- 1898. *Corbula (Cuneocorbula) Gregorioi* Cossmann. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 843 (part).
- 1919. *Corbula Gregorioi* Cossmann. HARRIS, Bull. Am. Paleontology, vol. 6, p. 185, pl. 56, figs. 14-16.

Under the discussion of *Corbula compressa* Lea: "Cette petite espèce est abondante à Claiborne et a été évidemment confondue avec de jeunes individus de *C. alabamiensis*; d'autant plus qu'il en existe une variété tout à fait rostrée moins aplatie et plus globuleuse, pour laquelle je propose le nom *C. Gregorioi*. J'ai fait représenter une valve de cette variété qui est encore plus commune que le type (pl. 1, fig. 4-5). Cette variété se distingue de *C. alabamiensis* par sa petite taille; elle est déjà globuleuse et toute formée à l'état adulte quand elle atteint 3 ou 4 mill.; elle a le bord palléal beaucoup plus arrondi que *C. alabamiensis*; cependant comme elle passe par des intermédiaires jusqu'à la forme *C. compressa*, je ne l'ai pas séparée comme espèce distincte." Cossmann, 1894.

*Corbula gregorioi* Cossmann has been recorded from a number of localities both in the upper and lower Claiborne, but there is some doubt about the identity of the specimens with the Cossmann type. The Mexican valves which have been referred tentatively to *Corbula gregorioi* agree very well with specimens from Claiborne, Alabama, determined by Cossmann in the collection of Truman H. Aldrich. They are all under 5 millimeters in height but they show no evidence of immaturity. The left valve is much the smaller and is more compressed than the right. The right valve is convex along both the vertical and the horizontal axes. The outline is trigonal except for the narrow and produced posterior extremity. The rostrum is sharply defined, and the valve a little depressed behind it; the posterior dorsal margin is raised a little and thickened. The umbone of the left valve is lower than that of the right, the ventral margin slightly oblique instead of arcuate, and the keel slightly less



sharp. The inner ventral margins of both valves are rather strongly incurved. The sculpture is similar in the two valves and similar roughly to that of *Corbula conradi* Dall. The concentric lirae are fairly strong and regular on the anterior and medial portions of the valve but become irregular toward the keel and behind it are reduced to feeble incrementals. The characters of the interior are not accessible.

The right valve is 4.2 millimeters high and 6.5 millimeters wide; the left valve, 3.6 millimeters high and 4.7 millimeters wide.

FIGURED SPECIMENS: U. S. Nat. Mus. 496340, from U.S.G.S. sta. 13861 (H-4).

The small size at apparent maturity isolates the species in the described Mexican fauna. It suggests a miniature *Corbula conradi* Dall, but the inequality of the valves is more pronounced in *C. gregorioi*.

DISTRIBUTION: Laredo formation: middle Laredo, U.S.G.S. sta. 13861 (H-4); U.S.G.S. sta. 13984 (H-6); U.S.G.S. sta. 13565 (H-12).

*Corbula (Varicorbula) laqueata* Casey

1829. ——— LESUEUR, Walnut Hills fossil shells, pl. 5, fig. 16?  
 1865. *Corbula laqueata* CONRAD, Am. Jour. Conchology, vol. 1, p. 3 (nomen nudum).  
 1865. *Corbula filosa* CONRAD, Am. Jour. Conchology, pp. 3, 145, pl. 20, fig. 5? (very poor figure).  
     Not *Corbula filosa* CONRAD, Am. Jour. Conchology, p. 137, pl. 10, fig. 7, 1865.  
 1866. *Corbula laqueata* CONRAD, Smith. Misc. Coll., vol. 7, no. 200, Check list of invertebrate fossils of North America, p. 28 (name only).  
 1890. ?*Corbula (Neaera) perdubia* De GREGORIO, Annales géologie paléontologie, vol. 8, p. 233, pl. 36, figs. 31, 32.  
 1898. *Corbula (Aloidis) perdubia* De Gregorio. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 844 (part).  
 1903. *Corbula laqueata* CASEY, Acad. Nat. Sci. Philadelphia, Proc., p. 261.

"Subtriangular, equilateral, length and height nearly equal; disk concentrically ribbed; ribs imbricated; posterior slope indented; extremity truncated.

"Length  $\frac{1}{4}$  inch.

"Locality.—Vicksburg, Miss." Conrad, 1865.

De Gregorio cited no locality, and his figure is not adequate to determine the species. Cossmann in his *Notes complémentaires*, 1894, assumed that De Gregorio's type of *perdubia* came from the Claiborne sand; Dall (1898) remarked that "Gregorio's specimens were not located, but probably are Jacksonian;" and Casey refers to the type as a Red Bluff species. De Gregorio's types were in Palermo. Though Conrad twice listed *laqueata*, he neither described nor figured it, so that the name had no standing until Casey identified it with Conrad's preoccupied *filosa* and added a descriptive discussion.

*Corbula laqueata* resembles a miniature *smithvillensis* from the lower Claiborne. Like other *Varicorbula*s, it is strongly inequivalve. The right valve is relatively high and trigonal with a full umbonal area incurved and prosogyrate at the tip and overtopping the low and inconspicuous umbone of the subquadrate left valve. The posterior keel is obtuse, and in the right valve a second obscure keel roughly parallels the dorsal margin. The flattened and inrolled tips of the umbones are free from sculpture. At about 2 millimeters on the right valve, a rugose concentric sculpture is initiated which becomes increasingly strong and continues with only a slight change in direction across both keels. The flattened left valve develops only a feeble and distant concentric sculpture which commonly dies out on the obscure posterior keel and is confined to the earlier two thirds of the shell. The later third of the left valve is sculptured only with a few incremental scratches and fortuitous radial threads. The dentition is normal, and the gutter on the interior of the right valve which receives the margin of the left is far within the shell. The dimensions of an average individual from the Byram marl are as follows: Right valve, height, 5.5 millimeters; width, 6.0 millimeters. Left valve of the same individual, height, 3.1 millimeters; width, 4.5 millimeters. Casey believed that he could recognize specific differences between the Red Bluff shell for which he retained the name *perdubia* De Gregorio and *laqueata* Conrad, cited from the Vicksburg. Our material does not indicate such a distinction.



The Mexican material is not well preserved but it shows the characteristic outline and sculpture of *laqueata* Casey.

DISTRIBUTION: Lower marine Oligocene sandstone: ?U.S.G.S. sta. 13510 (M-11).

*Corbula (Varicorbula) sp.*

(Plate 9, figure 17)

A single right valve (U. S. Nat. Mus. 496341) from the upper Laredo formation at U.S.G.S. sta. 13541 (J-13) recalls some of the variants of *Corbula gibbosa* Isaac Lea, 1833. It is a heavy trigonal shell, 10.5 millimeters high and 15 millimeters wide, the dorsal margins and the arcuate base crudely outlining the quadrant of a circle. The umbonal area is flattened and turned inward and, at the extreme tips, very slightly forward. Only feeble striae are visible on the umbones and the anterior area, but on the disk the irregular threads become increasingly coarse and more distant toward the ventral margin. The posterior extremity is battered, but there are vestiges of an obtuse keel close to the dorsal margin and of a slight warping of the valve in front of the keel. The shell is larger and relatively higher than *Corbula conradi*, and the sculpture pattern is more irregular. Only the single valve has been recovered.

*Corbula (Varicorbula) azucar* Gardner, n. sp.

(Plate 4, figure 13)

The figured right valve is transversely ovate-trigonal and rather highly inflated. Posteriorly the shell is snubbed and rostrate; the anterior end is sharply rounded, and the base line rather strongly arcuate. Except for the dorsal margins, the entire surface is rugose. Near the beaks, the concentric sculpture is fine and relatively sharp, but it coarsens abruptly when the valve is about 4 millimeters high. The adult rugae number between 2 and 3 to the millimeter and are regularly spaced, except for the crowding toward the ventral margin. The characters of the interior are not known.

DIMENSIONS: Height, 10.0 millimeters; width, 14.0 millimeters.

HOLOTYPE, A RIGHT VALVE: U. S. Nat. Mus. 496465.

TYPE LOCALITY: U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7° 30'E. of Ciudad Camargo, Tamaulipas. Lower or middle part of Jackson formation.

*Corbula azucar* is named from an old ford 2 kilometers up the Rio San Juan from the town of Camargo. *C. azucar* seems most closely comparable to *Corbula gibbosa* Lea from the Claiborne group, although it lacks the conspicuously bicarinate posterior area which characterizes the older form. The umbones of the Jackson shell are more rounded, the rostrum obtuse, and the sculpture less coarse and more subdued than that of Lea's species.

The specimens from U.S.G.S. sta. 13754 (M-7), the west side of the escarpment below Loma del Azucar, Tamaulipas, are more closely sculptured than the topotypes, but they probably come within the range of specific variation. Among them is a good left valve, transversely trigonal-ovate in outline and drawn out to the pinched postero-ventral extremity. It recalls in form and sculpture *Corbula conradi* Dall, the Claiborne species so widespread in the Rio Grande Embayment, but it is much larger and a little more coarsely sculptured.

Similar but not identical species are indicated in the upper Jackson by two strongly sculptured left valves, probably referable to two distinct species, one of them differing in the more conspicuous juvenile shell and the coarser and more distant adult sculpture, the other in the larger size and finer concentric threading. The first is from U.S.G.S. sta. 13598 (L-11), Presa El Mescal, Zacate, Nuevo León; the second from U.S.G.S. sta. 13529 (M-11).

DISTRIBUTION: Jackson formation: lower or middle Jackson, U.S.G.S. sta. 13754 (M-7); U.S.G.S. sta. 13504 (M-8); upper Jackson, U.S.G.S. sta. 14009 (M-13).

*Corbula (Varicorbula) sp.*

Corbulae not more than 5 millimeters high and similar in form and sculpture to miniature *Corbula wailesiana* Harris were recovered from the upper Jackson at U.S.G.S. sta. 13513 (M-11). They do not have the aspect of juveniles, and there are no comparable adults known from the area. The



outline, like that of *wailesiana*, is high, inflated, and trigonal. On the early half of the shell the sculpture is close and fine but becomes abruptly coarser and more distant ventrally. The same species, possibly new, may be represented in molds in the upper Jackson at U.S.G.S. sta. 13515 (M-12).

#### Subgenus *Caryocorbula* Gardner

1926. *Caryocorbula* GARDNER, Nautilus, vol. 40, p. 46.

*Cuneocorbula* DALL and of authors [not *Cuneocorbula* Cossmann, 1886].

TYPE, BY ORIGINAL DESIGNATION: *Corbula alabamiensis* Isaac Lea. Claiborne Eocene of the east coast and Gulf region, from South Carolina to the Rio Grande.

Shell small or of moderate dimensions; acutely keeled posteriorly; slightly inequivalve; right valve a little larger and higher relatively than the left; both valves concentrically rugose, the sculpture on the right valve in some species stronger and more regular than on the left; a microscopically fine radial lineation developed in some of the later species, particularly on the posterior keel; ligament, dental, muscle, and sinus characters similar to those of *Corbula*, *s. s.*

*Caryocorbula* includes most of the American species formerly assigned to *Cuneocorbula*. *Caryocorbula* differs from the Paris Basin group in that the shell is less trigonal, not so produced posteriorly, usually heavier, unirostrate rather than birostrate, and more strongly sculptured. *Caryocorbula* is abundantly represented in the Tertiary and Pleistocene of the east coast and Gulf and in the Recent east American waters.

#### *Corbula* (*Caryocorbula*) *aldrichi* Meyer

(Plate 8, figure? 12)

1885. *Corbula aldrichi* MEYER, Am. Jour. Sci., 3d ser., vol. 30, pp. 66, 67.

1886. *Corbula aldrichi* MEYER, Geol. Survey Alabama, Bull. 1, pt. 2, p. 83, pl. 1, fig. 21.

1897. *Corbula aldrichi* Meyer. HARRIS, Bull. Am. Paleontology, vol. 2, no. 9, p. 67, pl. 13, figs. 12, 13, 13a. (Synonymy excluded.)

"The two species in Claiborne, *C. gibbosa* Lea and *C. Murchisoni* Lea (*C. oniscus* Conr.) are two entirely different species . . . and neither of the three is identical with the species in Wood's Bluff, which I have had in my collection for some time under the name of *Corbula Aldrichi*, n. sp. It has radiating striae on the umbonial part of the surface, a characteristic which I have not seen before in a *Corbula*." Meyer, 1885.

"Rounded trigonal; ventricose; posterior side carinated; beak small, curved anteriorly, in the left valve nearly in the middle; right valve briefly rostrated; in both valves the umbonial part is without concentric ribs but with impressed, radiating lines—the ventral part with concentric ribs.

"*Locality*.—Wood's Bluff, Ala.

"The radiating lines cut only the first ribs and disappear completely at the ventral part. The species is similar to *Corbula gibbosa*, Lea., but distinguished mainly by the smooth umbonial part and the radiating lines." Meyer, 1886.

Topotypes of Meyer's species are larger and more strongly sculptured concentrically than either the few isolated individuals from the San Juan section or *Corbula* (*Caryocorbula*) *coloradoensis* Gardner (1935, pl. 4, fig. 1) from the Midway group of Texas. In the flattening of the umbones, the incipient radial sculpture, and the abrupt development of the concentric rugae near the ventral margin, these small forms are more like the Woods Bluff species than like the higher and more trigonal shells from the Midway. In the Midway form, the radial sculpture is more strongly developed than in either the Mexican or the Woods Bluff species, the concentric sculpture, less developed. The Mexican species is intermediate in age and possibly in shell characters between *C. coloradoensis* and *C. aldrichi*.

Only the right valve is known. The height of the figured specimen is 4.8 millimeters, the width, 5.6 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 496026 from U.S.G.S. sta. 13485 (E-18). Probably lower part of Indio formation.

DISTRIBUTION: Midway formation: upper Midway, U.S.G.S. sta. 13488 (D-18); upper Midway or lower Wilcox, U.S.G.S. sta. 13487 (D-18); U.S.G.S. sta. 13649 (E-18); U.S.G.S. sta. 13462 (E-18); U.S.G.S. sta. 13450 (D-19). Wilcox group, Indio formation: lower Indio, U.S.G.S. sta. 13669 (E-12); U.S.G.S. sta. 13485 (E-18); middle Indio, U.S.G.S. sta. 13675 (E-9).



*Corbula (Caryocorbula) conradi* Dall

(Plate 9, figures 13, 16)

1857. *Corbula nasuta* CONRAD in EMORY, Rept. U. S. Mex. Boundary Survey, vol. 1, p. 161, pl. 19, fig. 4.  
 Not *Corbula nasuta* SOWERBY, Zool. Soc. London, Proc., p. 35, 1833.  
 Not *Corbula nasuta* CONRAD, Fossil shells of the Tertiary formations of North America, p. 38, pl. 19, fig. 4, August, 1833.  
 Not *Corbula nasuta* CONRAD, Am. Jour. Sci., 2d ser., vol. 1, p. 398, pl. 4, fig. 4, 1846.  
 1898. *Corbula (Cuneocorbula) conradi* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 842.  
 1919. *Corbula conradi* DALL. HARRIS, Bull. Am. Paleontology, vol. 6, p. 186.  
 1923. *Corbula (Cuneocorbula) conradi* DALL. GARDNER, in TROWBRIDGE, U. S. Geol. Survey, Prof. Paper 131-D, pp. 95, 96.

Under the discussion of *Corbula (Cuneocorbula) alabamensis* Lea (= *Corbula nasuta* Conrad, not Sowerby), Dall wrote: "The *C. nasuta* Conrad of the Mex. Boundary Rep., i., p. 161, pl. xix., fig. 4, 1857, from western Texas, is obviously a distinct species, which may take the name of *C. conradi*."

Both Dall and Harris include the *nasuta* of the Mexican Boundary Report under the discussion of *Corbula alabamensis* Lea. The species figured by Conrad under the name of *nasuta* and the specimen which must serve as the holotype for *conradi* Dall is a left valve embedded in an indurated calcareous matrix. It is 5.4 millimeters high and 7.8 millimeters wide. The outline is transversely ovate-trigonal. The posterior area is moderately wide, and the angle of union with the disk acute. The central part of the disk is sharply and regularly concentrically threaded with about 25 lirations between the beaks and the ventral margin. The lirae tend to become obsolete toward the anterior dorsal margin and behind the posterior keel, and they may be reduced to feeble incrementals. The only locality given is "Western Texas." Similar calcareous sandstones outcrop along the line of strike of the lower and middle Laredo through most of Webb and Zapata counties. The figure in the report of the Boundary Survey is diagrammatic and does not give an accurate outline of the specimen that Conrad had before him.

The right valve of *Corbula conradi* is more inflated than the left and overlaps it slightly at the ventral and lateral margins. The beaks are subcentral, curved inward and slightly forward. The sculpture is similar on the two valves. It is stronger and more regular than that of *Corbula alabamensis*, and the shell is smaller and relatively higher than most of the species from the upper Claiborne of the eastern Gulf. *Corbula conradi* is, however, among the larger Corbulas of the lower Claiborne of the western Gulf. It may be almost double the size of the forms which have been referred to *C. gregorioi* Cossmann and is more trigonal and more strongly sculptured than *C. carli* Gardner.

**DIMENSIONS:** Unfigured Specimen, U. S. Nat. Mus. 496342, from U.S.G.S. sta. 13568 (G-11): Height (in crushed state), 5.5 millimeters; width, 8.2 millimeters; convexity of double valves, 6.0 millimeters. Figured specimen, U. S. Nat. Mus. 496343, from U.S.G.S. sta. 13602 (H-16): Height, 5.8 millimeters; width, 8.7 millimeters; convexity of double valves, 5.0 millimeters.

**DISTRIBUTION:** Laredo formation: The species is common at a number of localities in Webb and Zapata counties, Texas. Lower Laredo, U.S.G.S. sta. 13568 (G-11); U.S.G.S. sta. 13559 (H-12); U.S.G.S. sta. 13563 (H-12); ?U.S.G.S. sta. 13454 (H-15); U.S.G.S. sta. 13596 (H-15); U.S.G.S. sta. 13601 (H-16); U.S.G.S. sta. 13602 (H-16); U.S.G.S. sta. 13618 (H-17); U.S.G.S. sta. 13617 (H-18); U.S.G.S. sta. 13597 (I-18); ?U.S.G.S. sta. 13969 (I-19); middle Laredo, U.S.G.S. sta. 13772 (G-3); U.S.G.S. sta. 13990 (H-9); U.S.G.S. sta. 13634 (M-24); U.S.G.S. sta. 13642 (M-25); U.S.G.S. sta. 13643 (M-25); ?U.S.G.S. sta. 13641 (M-25); upper Laredo, U.S.G.S. sta. 13768 (G-3); ?U.S.G.S. sta. 13935 (H-3).

*Corbula (Caryocorbula) sp. cf. C. (C.) conradi* Dall

(Plate 9, figure 14)

Double valves from the lower Laredo sandstones outcropping at U.S.G.S. sta. 13563 (H-12) are more elongated transversely and more inflated than *Corbula conradi*. Except for a slight marginal overlap of the right valve posteriorly and ventrally, the two valves seem equal, although the shell is probably slightly warped, and the original outline obscured. The form can scarcely be included



under *conradi*, but it probably represents an undescribed and allied species. The shell (U. S. Nat. Mus. 496345) is 6 millimeters high, 9 millimeters wide, and the convexity of the double valves is 7.2 millimeters.

*Corbula* sp. cf. *C. (Caryocorbula) conradi* Dall

A right valve similar in sculpture pattern to that of *C. conradi* Dall, but higher and more trigonal, with broader, fuller umbones, was recovered from the middle Laredo at U.S.G.S. sta. 13634 (M-24). The shell, U. S. Nat. Mus. 496027, is 8.0 millimeters high and 11.0 millimeters wide, dimensions greater than those of the usual specimens of *conradi*. From the single valve, it is not possible definitely to fix even the subgenus.

*Corbula (Caryocorbula) santanensis* Gardner, n. sp.

(Plate 9, figure 20)

Shell of medium dimensions, not conspicuously inequivalve, transversely elongated; evenly but not very strongly inflated along both the vertical and the horizontal axes. Umbones full, submedial. Anterior end rather sharply rounded. Posterior carina well defined, set off by a slight depression in front of it and a warp in the ventral margin. An obscure second carina included within the posterior area and outlining a narrow lanceolate pseudo-escutcheon. Sculpture of low, narrow, crowded concentric rugae not developed upon the umbones and obsolete toward the anterior margin and behind the posterior keel. Left valve apparently a little higher and more trigonal than the right and overlapped by it. Characters of interior not known.

DIMENSIONS OF HOLOTYPE (a slightly crushed right valve): Height, 7.4 millimeters; width, 13.4 millimeters. Dimensions of paratype (right valve): Height, 8.7 millimeters; width, 14.0 millimeters.

HOLOTYPE, A RIGHT VALVE: U. S. Nat. Mus. 496344. Paratype, a right valve: U. S. Nat. Mus. 496464.

TYPE LOCALITY: Holotype, U.S.G.S. sta. 13634 (M-24); paratype, U.S.G.S. sta. 13643 (M-25). Middle part of Laredo formation.

*Corbula (Caryocorbula) santanensis* Gardner resembles a diminished *Corbula alabamiensis* Isaac Lea. Typical individuals stand apart from *Corbula conradi* Dall, but intermediate forms shorter and higher than the types are confusing. Though the types more obviously resemble the Claiborne species, the line of development indicated by the peripheral members leads toward *Corbula conradi* Dall, the prolific and protean *Corbula* restricted in its known distribution to the Rio Grande Embayment.

A closely related but possibly not identical species packs the Los Guerras beds at U.S.G.S. sta. 14027 (K-8) and is abundant in the Roma sand at U.S.G.S. sta. 13738 (J-6) and U.S.G.S. sta. 14025 (K-7). The species is smaller than *santanensis* Gardner, and the umbones lower and more compressed. The molds may have been slightly distorted in the soft sands in which they are preserved, but the topotypes of *C. santanensis* were recovered at a horizon appreciably lower than that of the Roma sand, and the differences are probably not without taxonomic significance. The same species as that collected near Ochoa occurs at the type outcrop of the Roma sand, on the north side of the Rio Grande directly above the International bridge at Roma.

DISTRIBUTION: Laredo formation: middle Laredo, U.S.G.S. sta. 13634 (M-24); U.S.G.S. sta. 13643 (M-25); ?U.S.G.S. sta. 13645 (M-25).

*Corbula (Caryocorbula?)* sp.

Molds of a transversely elongated *Corbula* of moderate dimensions are associated with an abundant bivalve fauna in a thin layer of creamy marl near the top of a highly colored clay series at U.S. G.S. sta. 13495 (H-3). The dimensions and outline of the double valves are similar to those of *Corbula (Caryocorbula) santanensis* Gardner, but the marl is probably of Yegua age. The species may be related to the common *Corbula* in the Los Guerras beds and the Roma sand.

*Corbula (Caryocorbula) engonatoides* Gardner

(Plate 9, figures 18, 19, 23)

1927. *Corbula (Caryocorbula) engonatoides* GARDNER, Washington Acad. Sci., Jour., vol. 17, p. 375, figs. 30, 31.



Shell small, the right valve slightly larger than the left, notably compressed, rather solid, rudely rectangular in outline; rostrate posteriorly, the rostrum acutely angular, sharply pinched, and slightly produced; area between the rostrum and the raised margin of the escutcheon concave. Umbones low, somewhat anterior, flattened on their summits, incurved and prosogyrate, the umbone of the right valve slightly in advance of that of the left. Lunule not differentiated. Escutcheon well defined both by the raised margin and the sharp change in the direction of the incrementals; wider in the right valve than in the left. Dorsal margins gently sloping. Anterior extremity well rounded, the posterior obliquely truncate; base line nearly horizontal, feebly constricted in front of the produced posterior keel. Sculpture absent or feeble dorsally; heavy concentric folds, commonly with a fine secondary striation, developed on the medial and ventral portions; concentric sculpture strong on the posterior keel, reduced to incrementals on the escutcheon. Ventral margin of right valve incurved and overlapping the left. Ligament short, inset, opisthodontic. Hinge normal; the single cardinal in the right valve moderately stout, conical, received in a correspondingly deep, subumbonal pit in the left valve; a dentate process developed behind the ligament support of the left valve but no true teeth. Interior more or less thickened in the adults. Muscle scars prominent. Pallial line distinct, obscurely truncate posteriorly but not sinuated.

**DIMENSIONS OF COTYPES:** Right valve, height, 5.3 millimeters; width, 8.5 millimeters; diameter, 2.4 millimeters; left valve of another individual, height, 5.5 millimeters; width, 9.0 millimeters; diameter, 2.5 millimeters.

**COTYPES:** The right and the left valves of different individuals, U. S. Nat. Mus. 369250.

**TYPE LOCALITY:** Smithville, Bastrop County, Texas.

**GEOLOGIC HORIZON:** Weches member of the Mount Selman formation.

**DIMENSIONS OF FIGURED DOUBLE VALVES:** Height, 5.0 millimeters; width, 7.0 millimeters; convexity of double valves, 3.6 millimeters.

**FIGURED DOUBLE VALVES:** U. S. Nat. Mus. 496121 from U.S.G.S. sta. 13596 (H-15), China, Carlos Cantú, Nuevo León. Lower part of Laredo formation.

*Corbula engonatoides* has been confused with *C. engonata* Conrad, a Vicksburg species. The older form has a more decided sculpture. The keel of *C. engonata* is distinct but not acute. In *C. engonatoides* it is not only acute but, toward the ventral margin, sharply pinched. Directly in front of the keel, in the adult, the basal margin is slightly constricted; the area behind it is decidedly concave. Neither the basal constriction nor the posterior depression has been observed in the Vicksburg form. The concentric sculpture, as a rule, is initiated later in *C. engonatoides* and is more pronounced. The very faint radial sculpture usually visible behind the keel of *C. engonata* has not been detected upon its progenitor.

North of the Rio Grande, *Corbula engonatoides* is indicative of the Weches member of the Mount Selman formation, but the figured specimen is from the basal Laredo formation and is associated with the abundant solitary coral *Balanophyllia irrorata* Conrad and large *Ostrea sellaeformis*. In the eastern Gulf Province, *C. engonatoides* has been reported from the lower part of the Lisbon formation.

*Corbula (Caryocorbula) sp. cf. C. (C.) engonata* Conrad

(Plate 9, figure 6)

A rather small and rather compressed, transversely elongate, rudely subquadrate right valve (U. S. Nat. Mus. 496347) from the middle part of the Laredo formation at U.S.G.S. sta. 13642 (M-25) apparently belongs to the group represented by *Corbula engonata* Conrad from the Vicksburg and *Corbula engonatoides* Gardner from the lower Laredo. The height is 5.4 millimeters, the width, 8.8 millimeters. The umbones are broad, low, and rather flat. The anterior end is broadly rounded, the posterior, truncate behind the rostrum. The basal margin is somewhat warped and turned inward. The rostrum is sharply pinched throughout its extent. The outer surface of the shell is wrinkled, the rugae strongest and most regular near the basal margin, and reduced behind the rostrum to incrementals. The interior is not accessible.

In outline, the valve recalls *Corbula carli*, but the umbones are less prominent and not so full, the rostrum sharper than that of the right valve of *carli*, and the sculpture much more feeble and irregular. Only the single valve is known.



*Corbula (Caryocorbula) carli* Gardner, n. sp.

(Plate 9, figures 10, 15)

Shell of moderate dimensions, subquadrate except for the broad full subcentral umbones. Right valve a little the larger; the right umbone a little higher and fuller than the left and impinging upon it; the lateral and dorsal margins overlapping slightly. Anterior extremity rounded, the posterior obliquely truncate, the ventral margin feebly arcuate. Posterior keel sharper in the left valve than in the right, the dorsal margin of the right valve thickened and turned inward over the left. Entire surface of both valves, except for the area behind the posterior keel, corded with 25 to 30 close-set rugae somewhat irregular in direction and spacing but presenting a fairly uniform general aspect. Characters of interior not known.

DIMENSIONS OF HOLOTYPE (DOUBLE VALVES): Height, 6.4 millimeters; width, 9.3 millimeters; convexity of double valves, 5.6 millimeters.

HOLOTYPE (DOUBLE VALVES): U. S. Nat. Mus. 496346.

TYPE LOCALITY: U.S.G.S. sta. 13600 (H-15), Carlos Cantú, China, Nuevo León. Lower part of the Laredo formation.

*Corbula carli* presents no striking characters, but it stands apart from the described species. Shells of the *Varicorbula* group are higher, more trigonal, and more decidedly inequivalve. It is more strongly sculptured than *conradi* and its allies and more elongated transversely. *Corbula engonata* is less inflated, more sharply rostrate, and less rugose. The type is unique.

*Corbula (Caryocorbula) engonata* Conrad

1829. —LESUEUR, Walnut Hills fossil shells, pl. 5, fig. 18.

Jan. 1848. *Corbula engonata* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, pp. 280, 294.

Aug. 1848. *Corbula engonata* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, pp. 111, 124, pl. 12, fig. 30.

Not *Corbula engonata* Conrad. ALDRICH, Geol. Survey Alabama, Bull. 1, p. 58, (name included in check list of Bells Landing fossils).

1898. *Corbula (Cuneocorbula) engonata* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, p. 846.

"Triangular, inequilateral, small; valves nearly or quite equally convex, and with angular concentric ridges; posterior slope concave; umbonal slope carinated. Length 3-10". Conrad, January, 1848.

The description was repeated in August of the same year in his further descriptions of fossils from the "Newer Eocene" from the vicinity of Vicksburg, Mississippi.

*Corbula engonata* is a small but rather heavy, transversely elongated species, the right valve a little more inflated than the left and slightly overlapping it along both the lateral and ventral margins. The umbones are broad and flattened and slightly anterior. In front of the umbones the shell is evenly rounded. The rostral angle on both valves is acute from the umbones to the posterior ventral margin. In front of the rostrum, the shell is slightly warped, and the basal margin of the right valve is more sinuous than that of the left. The area behind the rostrum is relatively wide on the right valve and slightly more concave than that in the left. The tooth in the right valve is strong, upturned at its pointed tip, and flattened along its inner face. The left socket is correspondingly deep. The scars of the muscle attachments and of the pallial line and the gutter paralleling the margin of the right valve are distinct. Except in the umbonal region, the surface of both valves is rather strongly and regularly corrugated.

A right valve, U. S. Nat. Mus. 496455 from U.S.G.S. sta. 13518 (N-10), is 5 millimeters high and 7.7 millimeters wide and differs not at all from the topotypic examples. In Mississippi, *Corbula engonata* is commonly abundant at every horizon from the Red Bluff through the Byram marl. Most of the Mexican material was collected from sandstones referred to the lower marine Oligocene.

DISTRIBUTION: Lower marine Oligocene sandstone: U.S.G.S. sta. 13505 (N-8); U.S.G.S. sta. 13518 (N-10); U.S.G.S. sta. 13510 (M-11); U.S.G.S. sta. 13511 (M-11); U.S.G.S. sta. 13522 (M-11); U.S.G.S. sta. 14056 (M-12); "Vicksburg" undifferentiated; U.S.G.S. sta. 14147 (O-22); Ashy sandstone at base of upper middle Oligocene sandstone, U.S.G.S. sta. 13539 (N-17).



Subgenus *Erodona* Bosc

1802. *Erodona* (Daudin MSS.?) Bosc, Histoire nat. coquilles, t. 2, p. 329.  
 1839. *Potamomya* SOWERBY, G. B., Jun., Conchological manual, p. 88.  
 Not *Potamomya* Sowerby, James, Mineral conchology, Great Britain, Index, p. 241, 1840.  
 1842. *Azara* D'ORBIGNY, Voyage dans l'Amérique Méridionale, t. 3, pt. 4, Paléontologie, p. 161.  
 1846. *Azara* D'ORBIGNY, Voyage dans l'Amérique Méridionale, t. 5, pt. 3, p. 572.  
 1847. *Erodina* GRAY, Zool. Soc. London, Proc., pt. 15, p. 191. Type: *Mya erodina* (error for *erodona*) Lamarck = *Erodona mactroides* Bosc.  
 1898. *Erodona* (Daudin?) Bosc. Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 4, pp. 836, 839.

TYPE, BY SUBSEQUENT DESIGNATION (DALL, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 836, not p. 839, 1898): *Erodona mactroides* Bosc.

Recent in the estuaries of southern Brazil and Uruguay. *Mya labiata* Maton, cited by Dall as the type (p. 839), is not one of the two species originally cited by Bosc.

Although Bosc credits the genus to Daudin<sup>2</sup> no record of the name can be found in Daudin's writings.

*Erodona* includes the relatively large and heavy corbulids in which the left valve is higher than the right and the right valve overlaps the left along the medial and posterior portion of the ventral margin and the posterior dorsal margin. The shell exhibits no sculpture excepting an incremental wrinkling and is covered in the Recent species by an epidermis. The ligament is entirely internal and is attached in the right valve to a deep subumbonal pit and in the left to a shelly plate produced obliquely or almost vertically beneath the umbones. The conical right anterior cardinal which characterizes most of the corbulids is not developed in *Erodona*, but the margins of the ligament pit in the right valve are raised into dentate processes, and the anterior is the more prominent. No teeth are developed in the left valve, but there is some modification of the dorsal margins in the subgenotype and other heavy species. D'Orbigny states that the animals of this group are separated from other *Corbula*, s. l., by the longer siphons and the closure of the mantle for about two thirds of its length. The habitat of the Recent species is highly characteristic. They live buried in the sand and mud at the mouths of the large rivers, notably La Plata, in Uruguay and southern Brazil, near the line of junction of the fresh water and the salt, and reputedly can endure a wide range in salinity.

The presence of this brackish-water Recent South American genus in any North American fauna is by no means established. The Upper Cretaceous species, *Corbula subtrigonalis* Meek and Hayden and *Corbula mactriformis* Meek and Hayden, which have been referred to *Erodona*, have a hooked anterior right cardinal similar to that of *Corbula*, s. s., and should not be included under *Erodona*. The illustration (Bull. Am. Paleont., vol. 1, no. 3, pl. 2, figs. 5, 5a) of *Corbula* (*Potamomya*) *priscopsis* Harris from the upper Miocene of the Galveston well is strongly suggestive of *Erodona*, but the specimen has not been examined. The species from the middle Oligocene of northeastern Mexico is not typical *Erodona*, but it has more in common with *Erodona* than with *Corbula*, s. s. It differs in the more oblique process for the attachment of the resilium, the less pronounced groove between that process and the dorsal margin, and in the broader, shallower pit for the anterior cardinal tooth.

*Corbula* (*Erodona*?) *carlotae* Gardner, n. sp.

(Plate 4, figure 9; Plate 10, figures 15, 19, 20)

Shell inequivalve, inequilateral, of only moderate dimensions for the group, not very heavy, transversely ovate-trigonal. Umbones rather high, flattened, and inrolled; right umbone lower than the left, conforming to the curvature beneath the left umbonal tip. Medial, posterior-ventral, and posterior-dorsal margins of left valve overlapped by the right. Anterior end strongly curved, the posterior produced and rostrate. Umbonal keel distinct, less acute toward the ventral margin. A second, less pronounced keel dorsal to the first and enclosing in the double valves a lanceolate area which simulates an escutcheon. Sculpture restricted to incremental striations with occasional resting stages toward the ventral margin. Hinge known only from the left valve. Ligament internal,

<sup>2</sup> "C'est à Daudin qu'est dû l'établissement de ce genre, formé sur deux coquilles du cabinet de Favannes." Bosc, 1802.



attached to a cuneate chondrophore projecting from the dorsal margin. Pit for the reception of the right umbonal tooth broad but not conspicuously high nor deep. Muscle, pedal, and pallial scars obscure.

**DIMENSIONS OF HOLOTYPE:** Height, 8.5 millimeters; width, 15.7 millimeters; diameter, 7.5 millimeters.

**TYPE MATERIAL:** Holotype, double valve; U. S. Nat. Mus. 496262; and one paratype, left valve, figured to show the hinge, U. S. Nat. Mus. 496263.

**TYPE LOCALITY:** Holotype, U.S.G.S. sta. 14023 (N-13); paratype, U.S.G.S. sta. 13539 (N-17). Ashy sandstone at base of upper middle Oligocene.

The chondrophore of the Mexican species differs from that of *E. mactroides* Bosc and *C. nimbose* Sowerby in the rugosities between the margin of the ligament area and the dorsal margin; the umbonal socket is broader and not so deep, and the shell is smaller and not so heavy.

Both the shells and the matrix are silicified, and most of the shells are preserved as double valves filled with a cherty matrix. So far as their characters can be determined, these middle Oligocene forms from northeastern Mexico seem more closely allied to *Erodona* than to any other group of *Corbula*. *Erodona*, however, is restricted in its known distribution to the recent estuarine faunas of the Uruguayan and south Brazilian rivers. *Corbula carlotae* is an Oligocene species of the Mexican Gulf Province associated with a fauna, in part marine, and perhaps in larger part brackish.

The species is named in honor of the unhappy victim of the third Napoleon's dream of Empire.

**DISTRIBUTION:** Ashy bed at base of upper middle Oligocene sandstone: U.S.G.S. sta. 14023 (N-13); U.S.G.S. sta. 13539 (N-17).

#### Family SAXICAVIDAE

##### Genus *Panope* Ménéard de la Groye

1807. *Panope* MÉNARD DE LA GROYE, Mémoire sur un nouveau genre de la famille des solénoides, p. 31.

1912. *Panope* DALL, Malacolog. Soc. London, Proc., vol. 10, p. 34.

**TYPE, BY SUBSEQUENT DESIGNATION** (Dall, Malacolog. Soc. London, Proc., vol. 10, p. 35, 1912): *Mya glycimeris* Born = *Panope aldrovandi* Ménéard de la Groye. Recent in the Mediterranean.

Shell usually large, equivalved, oblong, gaping at both ends. Surface smooth or concentrically furrowed. Ligament external, conspicuous. A single prominent conical subumbonal tooth in each valve. Pallial sinus deep.

The genus is recorded from the Upper Cretaceous; it culminated in the Tertiary and is represented today by about a dozen species occurring chiefly in the cooler waters.

##### *Panope oblongata* (Conrad)

Jan. 1848. *Panopaea oblongata* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 290.

Aug. 1848. *Panopaea oblongata* CONRAD, Acad. Nat. Sci. Philadelphia Jour., 2d ser., vol. 1, p. 121, pl. 13, fig. 12.

1898. *Panopea oblongata* Conrad. DALL, Wagner Free Inst. Sci. Trans., vol. 3, pt. 4, p. 828.

"Elongated, very inequilateral, ventricose; extremities rounded; umbo prominent, undulated; valves slightly contracted at base in a line with the umbones; valves gaping at both ends. Length  $3\frac{1}{2}$ .

"Occurs in its original vertical position generally with connected valves, but it is extremely friable and difficult to obtain." Conrad, Jan., 1848. Repeated in Aug., 1848.

Conrad's type is from Vicksburg, but the species is present also in the Jackson, both in the eastern and the western Gulf. In Starr County, Texas, near the Alta Vista Ranch house on the Escobares quadrangle, it is associated with abundant *Turritella arenicola* Harris. No other *Panope* has been reported from the upper Eocene of northeastern Mexico.

**DISTRIBUTION:** Jackson formation: upper Jackson, ?U.S.G.S. sta. 13529 (M-11); ?U.S.G.S. sta. 13520 (N-10). Oligocene series. "Vicksburg" undifferentiated, U.S.G.S. sta. 14146 (P-23).

#### Superfamily ADESMACEA

##### Family PHOLADIDAE

##### Genus *Jouannetia* Des Moulins

1828. *Jouannetia* DES MOULINS, Soc. linnéenne Bordeaux Bull. histoire nat., vol. 2, no. 12, p. 244 (vide Sherborn).



1933. *Jouannetia* Des Moulins. HERTHA SIEVERTS, Neues Jahrb., Beilage-Band 71, Abt. B., pp. 267-302. A morphologic study of *Jouannetia cumingii* (Sowerby) and a systematic review of the genus.

TYPE, BY MONOTYPY: *Jouannetia semicaudata* Des Moulins. Aquitanian of Merignac near Bordeaux.

Shell thin, ovoid to subglobose, the valves unequal and gaping. Anterior gape closed by a callus, which, proceeding from the left valve, covers the earliest part of the shell and arches over to the margin of the right valve. Posterior accessory flange on right valve. Beak bent forward, central, with a small internal ligament groove. A laminar incremental sculpture developed on either side of an oblique central or subcentral groove, strongest and most acute in front of the groove. Anterior area may be sharply rippled. Myophore rudimentary in both valves. Posterior adductor in *Jouannetia*, s. s., is attached to a thin shelly internal plate parallel to dorsal margin. Pallial line faint, deep within the shell.

The oldest known species of *Jouannetia* is "*Martesia*" *rotunda* Woods from the Upper Cretaceous of south and east England. It is recorded in the young Tertiary of south and eastern Asia, in the Recent tropical seas, and from the shores of Japan and New Zealand. Considering the relatively small number of individuals recovered, the number of species seems large.

*Jouannetia francesae* Gardner, n. sp.

(Plate 8, figure 10)

An imperfect right valve from the upper part of the Mount Selman formation at U.S.G.S. sta. 13627 (L-24) indicates a Recent Indo-Pacific group rarely recorded in the Gulf and mid-American Tertiary. The shell is small, probably not more than 8 millimeters in its greatest dimension. It is broadly depressed on either side of a diagonal groove extending from the umbones to the ventral margin. The larger anterior portion of the shell is feebly inflated, and cuneate. The diagonal groove is the longest side of the triangle, the ventral margin is oblique and merges into the lateral extremity in a wide arc. An obtusely lirate concentric sculpture becomes increasingly strong toward the ventral margin. The radials are poorly preserved but even in the fresh shell probably did not extend far back of the anterior lateral margin. The posterior portion of the valve is also cuneate and more depressed than the anterior; regular and evenly spaced concentric lirae are developed almost to the umbone. All trace of a posterior flange and the characters of the interior have been lost.

Woodring (*Miocene mollusks from Bowden, Jamaica*, Carnegie Inst. Washington, Pub. 366, p. 193), described a *Jouannetia* from the upper Miocene of Jamaica, the first and the only east American species of the genus yet recognized in the fossil or Recent state. The present species is named with much hesitation and only after the artist, Miss Frances Wieser, had established the characters by her excellent drawing.

The holotype, U. S. Nat. Mus. 496033, is 6 millimeters high and 8 millimeters wide.

Pholad, gen. and sp. ind.

(Plate 8, figure 11)

Two fragmentary specimens with the characteristic dash-dot sculpture of the pholads were recovered from U.S.G.S. sta. 13461 (D-4), in an arroyo west of the road to Guatempo, Mier, Nuevo León. One of them, U. S. Nat. Mus. 494967, is figured. The accessory plates on which the generic determinations within the family are based are not preserved, but it is of interest to record the existence of the family in the lower part of the Indio formation of northeastern Mexico.

Family TEREDINIDAE

Genus *Teredo* Linnaeus

1758. *Teredo* LINNAEUS, Systema Naturae, ed. 10, p. 651.

TYPE, BY SUBSEQUENT DESIGNATION (CHILDREN, Quart. Jour. Sci. London, vol. 14, p. 82, Oct., 1822): *Teredo navalis* Linnaeus. Recent in unprotected wood exposed for a length of time to the salt water of the European shores.



Shell reduced to spatulate or spoon-shaped pallets, the animal depending for its protection upon the burrow which it excavates in unprotected wood exposed for a length of time to salt water, and which it lines with a calcareous tube secreted by the mantle. The great majority of fossil species are known from the tubes alone so that their systematic position is uncertain.

*Teredo? ringens* Aldrich

1921. *Teredo ringens* ALDRICH, Bull. Am. Paleontology, vol. 9, no. 37, p. 17, pl. 2, fig. 12.  
 1935. *Teredo? ringens* Aldrich. GARDNER, Univ. Texas Bull. 3301, p. 195. (Not 1933 as on title page.)

"Shell substance thin, closed at the larger end like *Kuphus*; body of shell with raised, rather acute rings parallel to each other, and virtually at right angles to the longer diameter. Other fragments are not so strongly marked. Length of type specimen 37 mm. Average breadth 5 mm.

"Locality.—Sucarnochee clay bed, 3 miles south of Estelle, Ala.

"Type.—Alabama Museum, University, Ala." Aldrich, 1921.

Sharply annulate tubes, possibly identical with *T. ringens*, occur in the lower Eocene section on the Rio San Juan at U.S.G.S. sta. 13487 (D-18). The tubes are smaller, the annulations sharper and more crowded than those indicated by the Aldrich figure or in the species identified as *T. ringens* from the upper Midway of Maverick County, Texas.

The matrix in which the tubes from the Rio San Juan have been found is very dark and finely and closely laminated at right angles to the tubes. Dr. Roland Brown who was good enough to examine the specimen could find no trace of cellular plant structure and was not sure whether it had been lost in calcification or whether it had never been present. The sharp and regular annulation of the tube is unusual for *Teredo* and for *Kuphus* too. The aspect of the matrix is, however, so much more suggestive of plant growth than of indurated muds that the tubes have been referred to *Teredo* rather than to *Kuphus* which does not bore in the wood but digs in the soft bottoms of the inshore beaches.

Genus *Kuphus* Guettard

1770. *Kuphus* GUETTARD, Mémoires sur différentes parties des sciences et arts, III, p. 139.  
 1927. *Kuphus* Guettard. COX, Neogene and Quaternary Mollusca from the Zanzibar Protectorate, p. 62.

TYPE, BY SUBSEQUENT DESIGNATION (COX, Neogene and Quaternary Mollusca from the Zanzibar Protectorate, p. 62): *Teredo polythalamia* Linnaeus. "At the present day the species occurs in greatest abundance in the East Indies, but it has been recorded also from East Africa, Madagascar and the Red Sea." (Cox, 1927.)

"Boring vertically in the sand and mud of the sea-floor, not a wood-borer; animal encased in a long, thick, circular tube which, although usually straight, occasionally curves irregularly or bends at an angle, and which gradually increases in diameter from about 15 mm. at its upper end to 50 or 60 mm. at its lower end, when the maximum length (about 1 metre) is attained; surface of tube marked only with parallel growth-rugae and accidental scars; wider end of tube with a convexly sealed extremity; narrower (upper) end divided mesially by a partition that may extend for some distance down the tube, with a circular inner tube on each side of the partition, the inner tubes serving as outlets for the two siphons of the animal; valves of adult animal unknown."

Cox, 1927.

The separation of borings similar in a general way to those of the recent *Teredo* is made on the basis of the matrix in which the tubes are found. The wood borings are referred tentatively to *Teredo*, those in a matrix of sedimentary origin to *Kuphus*.

*Kuphus incrassatus* Gabb

1873. *Kuphus incrassatus* GABB, Am. Philos. Soc., Trans., vol. 15, p. 246.  
 1881. *Kuphus incrassatus* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 8, p. 342, pl. 44 figs. 12a-e.  
 1919. *Teredo* species, COOKE, Carnegie Inst. Washington, Pub. 291, p. 146.  
 1922. *Teredo (Kuphus) incrassata* (Gabb). PILSBRY, Acad. Nat. Sci. Philadelphia, Proc., vol. 73 pt. 2, p. 428.  
 1927. *Teredo (Kuphus) aff. polythalamia* (Linné). COX, Neogene and Quaternary Mollusca from the Zanzibar Protectorate, p. 62 (part).



1937. *Teredo? incrassata* (Gabb). MANSFIELD, Fla. Dept. Conservation, Geol. Bull. 15, p. 282, pl. 21, fig. 4.  
 1938. *Teredo? incrassata* Gabb. MANSFIELD, Washington Acad. Sci., Jour., p. 107, fig. 15.

"Tube large, cylindrical, irregular, surface covered by lines of growth, substance thick; apex often twisted or otherwise distorted; divided by a longitudinal septum into two tubes, often of unequal size.

"Fragments of this species are very common in the brown earthy shale east of Guayubin [Santo Domingo]. The largest I have seen is a little over an inch in diameter, and they usually occur in pieces of two or three inches in length. I have never seen it from other localities. The shelly walls are often so thickened that the internal diameter is not over half that of the outside." Gabb, 1873.

TYPE MATERIAL: Acad. Nat. Sci. Philadelphia, No. 2875.

The tubes from the upper Oligocene limestone of the Mendez area of Tamaulipas retain no characters by which they may be separated from those of the Antillean and Floridian Oligocene. They do not reach the maximum dimensions of the Cuban forms, but the average dimensions are comparable, and the strength and spacing of the annulations offer a similar range of variation. The division of the chambers toward the smaller end is also similar throughout the area of distribution. They have been recovered from U.S.G.S. stas. 14033 (P-25) and 14035 (P-26), near Mendez, San Fernando, Tamaulipas.

### Class SCAPHOPODA

#### Family DENTALIIDAE

#### Genus *Dentalium* Linnaeus

1758. *Dentalium* LINNAEUS, Systema naturae, ed. 10, p. 785.  
 1897. *Dentalium* Linnaeus. PILSBRY AND SHARP, Manual Conchology, vol. 17, p. xxix.  
 1920. *Dentalium* Linnaeus. HENDERSON, U. S. Nat. Mus., Bull. 111, p. 8.

TYPE, BY SUBSEQUENT DESIGNATION (SCHMIDT, C. F., Versuch über die beste Einricht., etc., pp. 151, 178, 181, Gotha, 1818): *Dentalium elephantinum* Linnaeus. Recent off Amboyna and the Philippine Islands.

Shell a curved and tapering tube, the diameter greatest at the aperture. Embryonic whorls minute, fragile, and lost at an early growth stage. A longitudinal sculpture usually developed, at least near the posterior extremity; shell smooth or merely annulated in a few of the smaller subgenera. Apical opening usually modified by a slit or notch due to absorption and in no way analogous to similar modifications in the gastropod apertures. Anterior opening circular or oblique, commonly modified by the longitudinal ribbing.

#### *Dentalium* sp.

Fragments of a slender but heavy-shelled species of *Dentalium* with crowded longitudinal lirae is poorly represented in the lower Midway east of Cerralvo at U.S.G.S. sta. 13463 (B-9). The tube of *Dentalium mediaviense* enlarges more rapidly, and the lirae are less closely spaced than in the Cerralvo form.

#### *Dentalium* sp. cf. *D. minutistriatum* Gabb

Scaphopods preserved, for the most part as internal molds, are abundant in the thin limestone of the lower Laredo at U.S.G.S. sta. 13619 (H-17), 1 kilometer south of Rancho Cantú, Carlos Cantú, China, Nuevo León. The shell is, as a rule, firmly embedded in the matrix, but a few fragments reveal a delicately sculptured surface similar to that of *D. minutistriatum* Gabb. The polished surfaces of the internal molds have the appearance of Caduli. Fragments suggesting *D. minutistriatum* in their outline and vestiges of surface pattern were recovered from the middle part of the Laredo formation at U.S.G.S. sta. 13861 (H-4) and from the upper part of the Laredo formation at U.S.G.S. sta. 13935 (H-3) and U.S.G.S. sta. 13541 (J-13).

#### Subgenus *Antalis* H. and A. Adams

1854. *Antalis* H. AND A. ADAMS, Genera of Recent Mollusca, vol. 1, p. 457.  
 1897. *Antalis* H. and A. Adams. PILSBRY AND SHARP, Manual conchology, vol. 17, p. 37.  
 1920. *Antalis* H. and A. Adams. HENDERSON, U. S. Nat. Mus. Bull. 111, p. 34.



TYPE, BY SUBSEQUENT DESIGNATION (PILSBRY AND SHARP, Manual conchology, vol. 17, 1897): *Dentalium entalis* Linnaeus. Recent in the North Atlantic and south to Spain.

"Tip prismatic or round, with primary riblets ranging from 6 to 18, which are less strongly developed and prominent than in *Dentalium* s.s. and generally disappear in the senescent stages of the shell if not earlier. The apical characters consist of a notch on the convex side or may be lacking. Transverse sculpture is variable or absent.

"As already noted the differences between this and the preceding subgenus [*Dentalium* s.s.] are not very sharply drawn. . . . The American species referred here are all less strongly ribbed than are those included under *Dentalium* s.s." Henderson, 1920.

*Dentalium (Antalis) mississippiense* Conrad

Jan. 1848. *Dentalium mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 282.

Aug. 1848. *Dentalium mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 112, pl. 11, fig. 1.

1903. *Dentalium mississippiense* Conrad. CASEY, Acad. Nat. Sci. Philadelphia, Proc., vol. 55, p. 266.

"Curved, attenuated above, longitudinally striated, the lines alternated in size. Length 2 1-10. Abundant. It differs from *D. thalloides*, nob., in having more numerous and much less prominent lines. It is very abundant.

"There is another species which occurs in fragments. It is small, rare, and is smooth, polished and curved." Conrad, 1848.

TYPE LOCALITY: Vicksburg, Mississippi.

"In the upper Vicksburg there are two large species of *Dentalium*; one—*D. mississippiense* of Conrad—is moderately large, gradually tapering throughout its length, feebly, evenly arcuate, having about 12 well-marked raised threads which become doubled or sometimes quadrupled in number anteriorly, but generally almost effaced at the mouth. A moderately large specimen measures 47 mm. in length by 4.6 mm. in maximum diameter." Casey, 1903.

The Mexican material is fragmentary but similar in the characters retained to the Vicksburg species described by Conrad and Casey. Imperfectly preserved forms not separable from *D. mississippiense* Conrad were collected from beds referred to the middle Jackson at U.S.G.S. sta. 14011, Alta Vista Ranch, Starr County, Texas.

DISTRIBUTION: Jackson formation: lower or middle Jackson, ?U.S.G.S. sta. 13508 (M-5 and M-6); ?U.S.G.S. sta. 13504 (M-8); ?U.S.G.S. sta. 13503 (N-8). Lower marine Oligocene sandstone: U.S.G.S. sta. 13505 (N-8); U.S.G.S. sta. 13509 (M-11).

Family SIPHONODENTALIIDAE

Genus *Cadulus* Philippi

1844. *Cadulus* PHILIPPI, Enumeratio molluscorum Siciliae, vol. 2, p. 209.

TYPE, BY MONOTYPY: *Dentalium ovulum* Philippi. Recent in the Mediterranean.

Shell tubular, more or less inflated medially or anteriorly and contracted near the aperture; maximum diameter often sharply defined by the so-called cingulum. Outline somewhat arcuate, especially along the outer, convex, or ventral margin and toward the posterior extremity. External surface without color in the Recent shells, usually polished, smooth, or faintly scratched incrementally. Posterior orifice simple or cut into 2 or 4 lobes. Anterior orifice circular, oval, or ovate, usually oblique to the axis.

The genotype and the other members of *Cadulus*, s. s., are stout, bulging, cask-shaped little tubes, as the name *Cadulus* indicates. The restricted genus has not been recognized in the Mexican faunas.

*Cadulus* sp.

A *Cadulus*, possibly allied to *Cadulus subcoarctatus* (Gabb) = *Ditrupa subcoarctata*, Gabb (Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 386, pl. 67, fig. 47) from Wheelock, Texas, occurs in the ferruginous concretions of the upper part of the Laredo formation at U.S.G.S. sta. 13544 (J-15). The tubes are slender with the maximum expansion near the anterior orifice, but the material is too poorly preserved to be determinable.



Subgenus *Polyschides* Pilsbry and Sharp

1898. *Polyschides* PILSBRY AND SHARP, Manual Conchology, vol. 17, p. 146.

TYPE, BY ORIGINAL DESIGNATION: *Siphonodentalium tetraschistum* Watson. Off Fernando Noronha in 25 fathoms (Challenger Expedition).

"Shell inflated above the middle or not much bulging; apex cut into a number of lobes, generally four, by as many slits." Pilsbry and Sharp, 1898.

*Cadulus (Polyschides) jacksonensis* Meyer

1885. *Cadulus jacksonensis* MEYER, Am. Jour. Sci., 3d ser., vol. 29, p. 462.  
 1886. *Cadulus jacksonensis* MEYER, Geol. Survey Alabama, Bull. 1, pt. 2, p. 65, pl. 3, figs. 8, 8a, 8b.  
 1892. *Cadulus jacksonensis* Meyer. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 444.  
 1895. *Cadulus jacksonensis* Meyer. ALDRICH, Bull. Am. Paleontology, vol. 1, no. 2, p. 4.  
 1937. *Cadulus jacksonensis* Meyer. PALMER, Bull. Am. Paleontology, vol. 7, p. 22.

"In Vicksburg and Jackson occur quite a number of species of *Cadulus*. One of them in Jackson, *Cadulus Jacksonensis*, n. sp., is the largest one. The inflation is near the anterior aperture. Aperture and section are not circular but ovate, the species, however, is not as much depressed as *Cadulus depressus* Meyer from Claiborne. The most characteristic is the posterior aperture. By four notches or fissures this end is divided into four turret-like appendages, similar to what Lea describes in his *Dentalium turritum*. Of these four prominences only the opposite ones are alike; two are small and simple, the other two broad and slightly emarginate in the middle. The largest species in Vicksburg has apparently the same form and almost the same aperture, but in the emargination of the two large appendages there seems to be a difference, and the specimens are smaller than in Jackson." Meyer, 1885.

*Cadulus jacksonensis* was considered by Dall and Aldrich as a synonym of *Cadulus newtonensis* Meyer and Aldrich, July 1886, that predated Bulletin 1 of the Alabama Survey in which Meyer's species was redescribed and figured. His earlier description without figure seems adequate to establish the name, so if they are synonymous, which seems improbable, the name of the lower Claiborne species must be suppressed.

Slender fragmentary caduli occur commonly in the calcareous sandstones of the lower or middle Jackson at U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7°30' E. of Ciudad Camargo and U.S.G.S. sta. 13503 (N-8), 20.8 kilometers S. 12°30' E. of Ciudad Camargo, Camargo, Tamaulipas. They resemble *Cadulus jacksonensis* in the details retained.

Subgenus *Gadila* Gray

1847. *Gadila* GRAY, Zool. Soc. London Proc., pt. 15, p. 159.

TYPE, BY ORIGINAL DESIGNATION: *Dentalium gadus* Montagu. "In many parts of the British Channel" (Montagu).

*Gadila* exhibits the toothlike outline of many of the species of *Polyschides*, but the margin of the apical orifice is simple and unslit.

*Cadulus (Gadila?) aldrichi* Gardner?

Synonymy and description of *Cadulus (Gadila?) aldrichi* Gardner:

1895. *Cadulus subcoarctatus* Gabb. ALDRICH, Bull. Am. Paleontology, vol. 1, No. 2, p. 4, pl. 1, fig. 4.  
 Not *Ditrupa subcoarctuata* Gabb, 1860, Acad. Nat. Sci. Philadelphia Jour., vol. 4, 2d ser., p. 386, pl. 67, fig. 47.  
 1899. *Cadulus abruptus* Aldrich and Meyer. HARRIS, Bull. Am. Paleontology, vol. 3, no. 11, p. 5 (part).  
 Not *Cadulus abruptus* Meyer and Aldrich, 1886, Cincinnati, Soc. Nat. Hist., Jour., vol. 9, p. 104, pl. 2, fig. 2.  
 1935. *Cadulus aldrichi* GARDNER, Univ. Texas Bull. 3301, p. 200, pl. 20, fig. 1. (Not 1933, as on title page.)

Shell scimitar-shaped, slender, and gradually tapering. Inner margin more strongly arcuate than the outer. Maximum diameter within the anterior fourth. Anterior orifice oblique to the axis, broadly elliptical in outline. Posterior orifice compressed.

DIMENSIONS: Height, 10 millimeters; greatest diameter, 1.5 millimeters.



HOLOTYPE: U. S. Nat. Mus. 373066.

TYPE LOCALITY: U.S.G.S. sta. 8245, Salado Creek, 5.3 miles southeast of San Antonio, Texas. Wills Point formation, upper Midway.

*Cadulus aldrichi* Gardner probably falls in the subgenus *Gadila* Gray and the section *Gadilopsis* Woodring, 1925 (Carnegie Inst. Washington, Pub. 366, p. 206; type by original designation *Ditrupa dentalina* Guppy, from the Miocene of Bowden, Jamaica). The group is characterized by a slender outline and a swelling very close to the anterior extremity. There is no trace, however, on the Eocene species of the oblique growth rings which are commonly developed on the posterior portion of the tube.

The Mexican material is fragmentary but seems closely related if not identical with that from the upper Midway of Texas.

DISTRIBUTION: Midway formation: upper Midway, U.S.G.S. sta. 13488 (D-18). Indio formation: lower Indio, U.S.G.S. sta. 13669 (E-12); middle Indio, U.S.G.S. sta. 13690 (E-5).

Class GASTROPODA

Subclass STREPTONEURA

Order ASPIDOBANCHIA

Superfamily TROCHACEA

Family SKENEIDAE

Genus *Teinostoma* A. Adams

1853. *Teinostoma* A. ADAMS, Zool. Soc. London, Proc., pt. 21, p. 183.

TYPE, BY MONOTYPY: *Teinostoma politum* A. Adams. Recent off the coast of Ecuador.

"Shell orbicular, depressed, subspiral, polished, last whorl rounded at the periphery; umbilical region covered with a large, flat callosity; aperture transverse, rounded, greatly produced and elongated, ending anteriorly in a slightly canaliculated point; inner lip smooth and callous, not emarginate or truncated, anteriorly; outer lip, thin, simple, not margined or reflected." (A. Adams, 1853.)

The genus is known from the Tertiary of the East Coast of North America and from the Paris Basin. The Recent forms occur most abundantly in the China and Japan seas, although a few representatives live in the tropical and subtropical waters of eastern America.

Section *Idioraphe* Pilsbry

1922. *Idioraphe* PILSBRY, Acad. Nat. Sci. Philadelphia, Proc., vol. 73, pt. 2, p. 398.

TYPE, BY ORIGINAL DESIGNATION: *Cyclops angulatus* Gabb. Miocene of Santo Domingo.

The section is characterized "by having the whorls enveloping, the suture at first closely coiled, but in the last whorl deviating abruptly." The periphery on the first half of the body whorl in the subgenotype is distinctly carinate.

*Teinostoma* sp.

A single specimen from U.S.G.S. sta. 13772 (G-3) establishes the occurrence of the genus and of the section *Idioraphe* in the middle part of the Laredo formation of northeastern Mexico. It is a minute lentil about 2.5 millimeters in greatest diameter belonging to an apparently undescribed species. The apical surface is flattened, the last whorl drawn over the spire and largely concealing it. The periphery is smoothly rounded. The characters of the umbilical area are obscured by persistently adherent matrix, but it was apparently rather wide. The aperture also is filled with matrix. There is no trace of a surface sculpture.

Superfamily NERITACEA

Family NERITIDAE

Genus *Nerita* Linnaeus

1758. *Nerita* LINNAEUS, Systema naturae, 10th ed., p. 776.

1889. *Nerita* Linnaeus. VON MARTENS, Systematisches Conchylien-Cabinet, pp. 1-130; pls. 1-15.

1909. *Nerita* Adanson. BOURNE, Zool. Soc. London, Proc. for Nov. 17, 1908, pp. 845-847.

1923. *Nerita* Linnaeus. BAKER, Acad. Nat. Sci. Philadelphia, Proc., vol. 75, pp. 134-135, 168.

TYPE, BY SUBSEQUENT DESIGNATION (Montfort, 1810, Conchyliologie Systématique, t. 2, p. 347): *Nerita peloronta* Linnaeus. Recent in the West Indies.



The *Neritas* are heavy-shelled, few-whorled, ovoid or semiglobose, imperforate, operculate, marine gastropods. The spire is low, and the body relatively large and inflated. The inner margin of the obliquely semielliptical aperture is thickened, flattened, and usually serrate, at least in some of the growth stages.

*Nerita* inhabits the shores of all the tropical seas. The closely related *Neritina* is also tropical in its distribution, but it is nonmarine. *Nerita* is usually associated with coral reefs and rocky coasts, most commonly those washed by salt spray.

The group has received the attention of naturalists since the day of Aristotle, who first recorded the name *Nerita* and noted its habit of clinging to rocks. It is of unusual interest to the malacologist, since there are certain anatomical characters which the Neritidae alone among the Prosobranchia share with the Pulmonates. A genetic relationship has been suggested (Simroth, Mal. Soc. London, Proc., vol. 9, p. 31, 1910).

#### *Nerita tampaënsis* Dall

1892. *Nerita tampaënsis* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 421, pl. 17, fig. 3.

1915. *Nerita tampaënsis* DALL, U. S. Nat. Mus., Bull. 90, p. 114, pl. 16, fig. 2.

"Shell rather small, with a depressed spire and three whorls; surface varying from nearly smooth with obsolete spiral sculpture to strongly irregularly spirally ribbed with narrow rounded ribs separated by wider interspaces and crossed by more or less conspicuous lines of growth; there is no fine striation and the ribs are extremely irregular in size when strong, and become almost entirely obsolete in some specimens; they are more sparse on the upper surface than on the periphery; aperture half-moon-shaped, outer lip thickened, but not dentate; inner lip with a broad, rather thin callus with obscure tubercles on the lower portion; pillar thin, with a few obscure denticles near the middle. Alt. 10.0; max. lon. 12.5 mm.

"The specimen figured happens to be nearly smooth; on the spire there are some obscure oblique wrinkles. A specimen from the hammock shows strong, irregular ribbing, of which there are only traces seen on the one figured. All the specimens obtained at Ballast Point, where it seems rare, seem to have been more or less worn before being fossilized. This is the first species of *Nerita* described from the Atlantic Tertiary rocks, and resembles some of the Pacific coast recent species more than it does the recent species of the Atlantic coast and the West Indies." Dall, 1892.

The recovery of an individual seemingly identical with the Tampa species of *Nerita* is significant. The records of the genus are extremely rare, and the species were probably short ranging. Brackish-water conditions may have existed along the shore of the ancient Gulf of Mexico for a short period during the late Oligocene, and similar environments rather than synchronicity may account for the likeness of the fauna to that which flourished on the eastern shore of the Gulf of Mexico during the early Miocene. The field relations in northeastern Mexico do not permit the reference of this faunal horizon to the Miocene.

DISTRIBUTION: Upper marine Oligocene limestone: U.S.G.S. sta. 13579 (P-25), 5 kilometers N. 21° W. of Mendez, Tamaulipas.

#### *Nerita* sp.

An ovate shell 8.5 millimeters high from the lower marine Oligocene sandstone at U.S.G.S. sta. 13510 (M-11) has retained the characteristic zigzag color marking.

Two slightly smaller, badly weathered shells from the ash bed at the base of the middle Oligocene sandstone at U.S.G.S. sta. 14023 (N-13) have lost the color pattern, but the fine serrations on the columellar margin are retained.

### Order PECTINIBRANCHIATA

#### Suborder GYMNOGLOSSA

#### Family PYRAMIDELLIDAE

#### Genus *Turbonilla* Risso

1826. *Turbonilla* RISSO, Hist. Nat. des principales productions de Europe Mérid., vol. 4, p. 224.

TYPE, BY SUBSEQUENT DESIGNATION (Herrmannsen, Indicis Generum Malacozoorum, Primordia, vol. 2, Supplementa et Corrigenda, p. 136, 1852): *Turbonilla costulata* Risso. "Fossile a Saint-Jean."

The group has been the subject of monographic study by Dall and Bartsch and later by Bartsch alone. It includes many species which have in common small slender, polygyrate shells, axially ribbed, with or without spiral sculpture and with a relatively feeble pillar plication.



*Turbonilla bidentata* (Meyer)?

(Plate 27, figure 16)

Synonymy and description of *Turbonilla bidentata* (Meyer):

1886. *Odostomia bidentata* MEYER, GEOL. Survey Alabama, Bull. 1, pt. 2, p. 70, pl. 1, fig. 3.  
 1890. *Odostomia bidentata* Meyer. DE GREGORIO, Annales Géologie Paléontologie, vol. 8, p. 158; pl. 15, fig. 28.  
 1894. *Turbonilla bidentata* (Meyer). COSSMANN, Essais Paléoconchologie Comp., vol. 12, p. 24.  
 1921. *Turbonilla* (*Pyrgolamprus*) *bidentata* (Meyer). COSSMANN, Essais Paléoconchologie Comp., vol. 12, p. 288.  
 1937. *Turbonilla bidentata* (Meyer). K. V. W. PALMER, Bull. Am. Paleontology, vol. 7, p. 80, pl. 8, fig. 3.

"Subulate, whorls eight; nucleus and first whorl smooth, elsewhere furnished with transverse ribs; suture impressed; base rounded, smooth; columella with a very prominent oblique fold, and a second indistinct one below it.

"*Locality*.—Claiborne, Ala.

"The ribs have in one of the three specimens a tendency to become obsolete, especially toward the lower part of each whorl. The lower fold will be better seen in fragments, with exposed columella, than in a perfect mouth." Meyer, 1886.

A decollated shell of 8 narrow, flat-sided whorls, including the short body, offers no characters by which it may be separated from Meyer's Claiborne species. The riblets range from 15 to 20 to the whorl. They are feebly protractive, and the tendency to become obsolete upon the anterior portion of the whorl is marked, though the illustration seems to have emphasized that character unduly. The anterior extremity unfortunately is damaged, but traces of a single columellar fold have been retained.

DIMENSIONS OF FIGURED SPECIMEN: Height, 4.5 millimeters; diameter, 1.6 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 497443 from U.S.S.G. sta. 13504 (M-8), 15.9 kilometers S. 7° 30' E. of Ciudad Camargo, Camargo, Tamaulipas. The horizon is in the lower or middle part of the Jackson formation.

## Suborder PTENOGLOSSA

## Family EPITONIDAE

Genus *Cirsotrema* Mörch

1852. *Cirsotrema* MÖRCH, Catalogus conchyliorum quae reliquit D. Alphonso d'Aguirra et Gadea Comes de Yoldi, p. 49.

TYPE, BY MONOTYPY: *Scalaria varicosa* Lamarck. Recent in the Indian Ocean.

*Cirsotrema* includes shells of only moderate dimensions, decorated with varices of more or less unequal strength and elevation and a relatively feeble spiral sculpture, strongest in the intervarical areas but, in the typical species, crenulating the varical lamellae. At the base of the body the lamellae are united by a strong cord to form the basal disk. The varices in front of the cord are similar in character to those behind it.

*Cirsotrema* is recorded from the Eocene of the Paris Basin, southern France, Egypt, and the Gulf region; from the Oligocene of northern Germany; from the Miocene of southern Europe; the Sind and Australia; from the Pliocene of the Mediterranean Province and southwestern France; and it is living in the Indo-Pacific region.

Section *Coroniscala* De Boury

1909. *Coroniscala* DE BOURY, Jour. Conchyliologie, vol. 57, p. 255.

TYPE, BY MONOTYPY AND ORIGINAL DESIGNATION: *Scala coronalis* Deshayes. Eocene (Lutetian) of the Paris Basin.

The section differs from *Cirsotrema*, s. s., in that the varices are spinose posteriorly and not crenulated by the spirals. The group is widespread during the Eocene and is recorded from the Oligocene of Germany, the Miocene of northern Italy, and the Pliocene of Calabria.



*Cirsotrema? cortezi* Gardner, n. sp.

(Plate 15, figure 18)

Shell of moderate dimensions, probably squat and acutely tapering, only the 3 final whorls remaining. Inflation of the whorls strong and even. Varices heavy, laminar, elevated, apparently equal except for the expanded terminal varix, flattened at the posterior suture and bent to the left, 18 on the earliest of the remaining whorls, 15 on the body; some slight indication of hooks on the shoulder, but the varices are broken and their original contour lost. Basal disk outlined by a strong spiral cord uniting the varices; varices continued in front of the cord with undiminished strength. Three obscure lirae in the intervarical areas on the medial portion of the body whorl, reduced on the final whorl of the spire to 2 and on the preceding whorl to faint spiral scratches. Aperture set at a high angle to the axis of the shell, subcircular, the curvature of the outer lip higher than that of the inner. Other characters of aperture concealed by the matrix.

DIMENSIONS OF IMPERFECT HOLOTYPE: Height, 10 millimeters; diameter, including imperfect varices, 6.9 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497118.

TYPE LOCALITY: U.S.G.S. sta. 13467 (M-11), 1.5 kilometers east-north east of Rancho La Rosita, Zacate, Nuevo León. Middle or upper part of Jackson formation.

The incomplete shell of a closely related if not identical species was collected in the upper part of the Jackson formation at U.S.G.S. sta. 14009 (M-13).

Genus *Scalina* Conrad

1865. *Scalina* CONRAD, Am. Jour. Conchology, vol. 1, p. 27. No description, but *Scala staminea* Conrad and *Scala triginti[a]naria* Conrad listed.  
TYPE, BY SUBSEQUENT DESIGNATION (PALMER, Bull. Am. Paleontology, vol. 7, p. 102, 1937): *Scala staminea* Conrad. "Gosport sand" of Alabama.
1908. *Ferminoscala* DALL, Mus. Comp. Zool. Harvard College, Bull., vol. 43, no. 6, p. 315.  
TYPE, BY ORIGINAL DESIGNATION: *Scala ferminiana* Dall (*Epitonium* (*Ferminoscala*) *ferminianum* Dall). Recent on the west coast from the Gulf of California to Panama.
1911. *Textiscala* DE BOURY, Jour. Conchyliologie, vol. 58, pp. 216, 218, 222. Type by original designation: *Scalaria decussata* Lamarck. Eocene of the Paris Basin.

De Boury's "Étude sur les sous-genres de Scalidae" was apparently awaiting publication when Dall's report upon the Albatross dredgings came out. De Boury noted the similarity of *Textiscala* to *Ferminoscala* and excused the retention of *Textiscala* by the seeming difference in the outer lip. None of the species of his *Textiscala* showed a varicose outer lip, and, as a matter of fact, although Dall includes the character in his description, none of his specimens show it.

The spiral sculpture in *Scalina* is relatively more prominent than in *Acrilla* H. Adams, and the axial sculpture usually finer, sharper, and less crowded. The spaces between the spirals show under the microscope a crowded linear grooving. The axials are very fine, sharp laminae not very closely spaced. The basal disk is conspicuous.

The genotype is a rare shell not represented in the collections of the U. S. National Museum. The group is widespread in the Eocene of Europe and the Gulf region; in the later Tertiary of northern Italy, the southern United States and the mid-Americas; and in the Recent faunas of the East Coast, the Gulf Region, and the West Coast.

*Scalina* sp. cf. *S. staminea* Conrad

Description and synonymy of *Scalina staminea* Conrad:

1860. *Scalaria staminea* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 294.  
1865. *Scala* (*Scalina*) *staminea* CONRAD, Am. Jour. Conchology, vol. 1, p. 27.  
1937. *Scalina staminea* Conrad. PALMER, Bull. Am. Paleontology, vol. 7, p. 102, pl. 8, fig. 16.

"Subulate; whorls regularly rounded; ribs and revolving lines closely arranged, very fine; base carinated; below the carina ribs obsolete.

"Locality.—Claiborne, Alabama." Conrad, 1860.

Mrs. Palmer made the following observations upon the type, which is deposited in the Academy of Natural Sciences in Philadelphia:



"The holotype consists of three whorls. The whorls are regularly rounded, with cancellate sculpture; there are ten or eleven, spiral ribs crossed by longitudinal ribs of equal strength; the body whorl is carinated at the base with fine, cancellate sculpture below the carination. The aperture is broken. The whorls are more convex than those of *S. trigintanaria* (Conrad) of the Vicksburg Oligocene to which it is related."

Two complete whorls of a moderately large individual were recovered from U.S.G.S. sta. 13570 (H-12) in the middle part of the Laredo formation in General Bravo, Carlos Cantú, Nuevo León. The diameter of the larger whorl is 8.5 millimeters; that of the holotype is 8 millimeters, *vide* Mrs. Palmer. The inflation is similar in the two forms, but the netting is more open in the Mexican species. The shells probably represent two related but distinct species.

*Scalina trigintanaria* (Conrad)?

(Plate 24, figure 9)

Synonymy and description of *Scalina trigintanaria* (Conrad):

Jan., 1848. *Scalaria trigintanaria* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 283.

Aug., 1848. *Scalaria trigintanaria* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 114, pl. 11, fig. 14.

1865. *Scala* (*Scalina*) *trigintanaria* CONRAD, Am. Jour. Conchology, vol. 1, p. 27.

"Turreted, whorls convex, cancellated with numerous prominent lines, the longitudinal one lamellaeform and elevated towards the suture, about 32 in number on the body whorl, which is obtusely carinated; revolving lines equally prominent with the longitudinal, but thicker; base below the carina with minute revolving lines. Length 9-10. Very rare." Conrad, Jan. 1848.

TYPE LOCALITY: Vicksburg, Mississippi.

Conrad's figure, though crude, indicates very well the characteristic features of the species, the slender, elevated spire, the basal disk, distinct in texture and in the abruptly subdued sculpture, and the numerous free axial lamellae. The flattened lirae that cancellate the axials are not well shown. Eight or 9 such lirae is a usual number, and between each pair there may be several exceedingly fine spiral filaments. The rectangular pits enclosed by the spirals and the varices are slightly elongated transversely. The sutures are deeply impressed and partially filled with the lamellae which are bent sharply to the left directly in front of the suture.

The individual from the base of the upper middle Oligocene sandstone, U. S. Nat. Mus. 497446 from U.S.G.S. sta. 13535 (N-17) is small and probably not fully adult, but it cannot be separated from the Vicksburg species. A similar form from the lower Oligocene sandstone was collected at U.S.G.S. sta. 13522 (M-11). Two allied but imperfectly preserved individuals from the upper part of the Jackson formation at U.S.G.S. sta. 14009 (M-13) and the figured specimen (Pl. 24, fig. 8), U. S. Nat. Mus. 497266 from the lower marine Oligocene sandstone at U.S.G.S. sta. 13509 (M-11) are more strongly sculptured spirally and probably indicate a distinct race. There are only 5 primary spirals on the adult whorls of the larger specimen from the Jackson, but they are stronger relatively and less uniform in elevation than those of the Oligocene shells.

*Scalina escandoni* Gardner, n. sp.

(Plate 16, figure 16)

Shell of moderate dimensions for the genus, slender, turritid. Only the final 5 whorls of the conch preserved, the whorls evenly inflated, constricted at the strongly impressed sutures, regularly increasing in diameter. Sculpture uniform over most of the conch; 8 spirals on the later whorls, slightly fewer on the earlier, smooth and simple, more distant and less regular in size and spacing on the posterior part of the whorl than on the anterior; a microscopically fine spiral lineation, the characteristic sculpture of the genus, developed in the interspiral channels; axials sharply laminar, arcuately retractive, 25 on the later whorls of the type, fairly uniform in strength and spacing. Basal disk defined by the thickening of the shell substance and the change in the sculpture pattern; the periphery projecting slightly beyond the plane of the spirals, the disk itself sculptured only with exceedingly fine and fairly even spirals and with axials which represent exaggerated growth stages radiating from the pillar like the spokes of a wheel. Aperture imperfect. Outer lip thin in all available specimens, apparently an adult character. Pillar reinforced, the umbilicus entirely closed.



DIMENSIONS OF IMPERFECT HOLOTYPE: Height, 20 millimeters; diameter, 8 millimeters.

HOLOTYPE: U. S. Nat. Mus. 495098.

TYPE LOCALITY: U.S.G.S. sta. 13588 (W-30); 620 meters N. 55° W. from the church tower in San Fernando. Guajolote formation.

A single individual similar in general aspect to *Scalina escandoni*, but with the basal disk either undeveloped or broken away, is associated with *escandoni* at the type locality.

*Scalina escandoni* is very close to fragmentary specimens from the Chipola formation in Florida. The forms from Bowden, Jamaica, show a more strongly reticulate sculpture.

The species is named in remembrance of the Colonel Escandon who was in command of the organized colonization of El Nuevo Santander in the middle of the eighteenth century and was stationed for a time at San Fernando.

#### *Incertae sedis*

A number of Oligocene epitonids do not seem to conform to any of the described groups. One species is very slender, with almost parallel sides, the whorls with a feeble inflation most pronounced in front of the periphery, and slightly constricted at the sutures. The axials are numerous (15 to 20 to the whorl), blunt, strongly retractive, and arranged, for the most part, in continuous series which perform a little more than half a revolution about the axis. Spiral sculpture is not developed. There is probably a basal disk, but the characters of the aperture have been lost. Such a form is present in the lower Oligocene at U.S.G.S. sta. 13510 (M-11), in an arroyo 1035 meters south and 305 meters east of Rancho La Copa, Zacate, Nuevo León.

In another slightly less slender species, similar in general aspect, the varices are acute and directed toward the aperture. A feeble spiral sculpture is developed in the intervarical areas. The characters of the base and of the aperture are not known. Similar forms occur in the lower marine Oligocene sandstone, U.S.G.S. sta. 13509 (M-11); and U.S.G.S. sta. 13522 (M-11); and the upper marine sandstone, at U.S.G.S. sta. 13535 (N-17).

#### Family EPITONIIDAE?

##### Genus *Gegania* Jeffreys

1884. *Gegania* JEFFREYS, Zool. Soc. London, Proc., pt. 25, p. 365.

TYPE, BY MONOTYPY: *Gegania pinguis* Jeffreys. Collected by the Porcupine Expedition off Cape Mondego, Lat. 39° 39' to 39° 55' N., in 740 to 1095 fathoms.

1833. *Tuba* ISAAC LEA, Contributions to geology, p. 127. (Not *Tuba* Renier, 1804, Vermes).

TYPE, BY SUBSEQUENT DESIGNATION (Cossmann, Soc., royale Malacolog. Belgique Annales, vol. 23, p. 316, 1888): *Tuba alternata* Lea = *Littorina antiquata* Conrad. Claiborne Eocene of the Gulf Province.

Herrmannsen, 1849, designated as type of *Tuba* "*Turbo sculptus*" Pilkington (an error, doubtless, for *Turbo sulcatus* Pilkington) a Bartonian shell mentioned by Lea in his original description. The error, however, makes the designation worthless.

"Shell conical, reticulated, not umbilicated; nucleus globular and intorted, not spiral, nor sinistral. Differs from *Mathilda* in having a short spire and an intorted but not a heterostrophe nucleus." Jeffreys, 1884.

The nucleus is bulbous and tipped at the apex like that of *Architectonica*. Even though the initial tendency of the nuclear whorls is sinistral as Dall maintained, when he placed the family in the Mathildiidae, the fact that only the dextral whorls are exposed may be of importance taxonomically. The genera most closely related seem to fall in the families Architectonicidae and Epitoniidae, the two main groups which make up the Ptenoglossa (*fide* Morley Davies), and *Gegania* is tentatively placed within the wide limits of the Epitoniidae.

The genus has been reported from strata as early as the Jurassic and still persists in restricted numbers in the warmer seas.



*Gegania texana* (Palmer)?

(Plate 15, figures 14, 17)

Synonymy and description of *Gegania texana* (Palmer):1937. *Tuba antiquata texana* PALMER, Bull. Am. Paleontology, vol. 7, p. 92, pl. 9, figs. 8, 9.

"Shell large, spire high for the species; whorls six; nucleus typical; sculpture of the post-nuclear whorls consists of four, strong, primary ribs, the first and fourth smaller than the two middle ribs; two, middle, spiral ribs increased in size making the whorls of the spire bicarinate; three to six, fine, thread-like, spiral ribs occur between the primary ribs; all crossed by longitudinal threads which at the intersection form a node; below the strong bicarination of the body whorl nine to eleven, spiral ribs occur to the base; one or more, spiral threads alternate with the primary series.

"This species differs from *T. antiquata* s.s. and the variety *striata* in being more elevated in the bicarination of the whorls and by the greater number of fine, thread-like spirals.

"Prof. Harris pointed out, in his Texas Eocene manuscript, this variation which occurs in Texas material. He gave the name *texana*. Although the name was never published, workers so labelled specimens. To save confusion if a new name were added, Prof. Harris's name is retained.

"*Dimensions*.—Height, 17 mm.; greatest diameter, 10 mm., holotype. Height, 11 mm.; greatest diameter, 8 mm., paratype. Height, 15 mm.; greatest diameter, 8 mm., paratype.

"*Holotype*.—No. 2743; paratypes 2744, 2745, Paleontological Research Institution.

"*Occurrence*.—Lower Claiborne; locality 733." Palmer, 1937.

"Locality 733" is Smithville, Bastrop County, Texas.

The strength and regularity of the incremental corrugation is one of the good determining diagnostics in the Smithville species. The fragmentary Mexican individuals have preserved this character very well. Figure 14 (U. S. Nat. Mus. 497115) may represent the latest whorls of the spire of *texana*, and Figure 17 (U. S. Nat. Mus. 497117), the earlier whorls in which the apical angle is smaller.

Both specimens were collected from the lower part of the Laredo formation at U.S.G.S. sta. 13596 (H-15).

Another form, possibly distinct both from *texana* and from *antiquata*, may be represented by an incomplete individual from beds of probable upper Laredo age at U.S.G.S. sta. 13983 (G-4).

## Family ARCHITECTONICIDAE

Genus *Architectonica* (Bolten) Roeding

1798. *Architectonica* (Bolten) ROEDING, Museum Boltenianum, pt. 2, p. 78 = *Solarium* Lamarck, 1799, Prodrome d'une nouvelle classification des coquilles, Soc. hist. nat. Paris Mém., p. 74.

1909. *Architectonica* Bolten. DALL, U. S. Geol. Survey, Prof. Paper 59, p. 80.

TYPE, BY SUBSEQUENT DESIGNATION (GRAY, Zool. Soc. London, Proc., pt. 15, p. 151, 1847):

*Trochus perspectivus* Linnaeus. Recent in the Indo-Pacific.

Shell solid, perforate. Outline subdiscoidal to depressed-conic. Early part of protoconchal whorls inverted, only the final smooth, inflated turn visible on the apical surface. Whorls of conch numerous, regularly increasing in size. Periphery rounded or carinate. Dominant sculpture of simple or beaded spirals. Aperture semielliptical to subquadrate. Outer lip thin and sharp. Columella usually straight, simple. Umbilicus funicular or scalar.

*Architectonica* is uncommonly well represented, both in species and individuals, in the Eocene of the Gulf. The Recent species, the "sun-dial" shells, are relatively few in number and are restricted to the warmer waters.

*Architectonica* sp.

Indeterminate fragments of a depressed conic and simply sculptured species were recovered from the concretions in the middle Indio sandstone at U.S.G.S. sta. 13466 (D-11) 4 kilometers north of Los Herreras, Nuevo León. The protoconch and possibly the earliest whorl of the conch have been lost. Between 4 and 5 whorls still remain. Traces of a fine spiral sculpture upon the apical surface may still be caught. The fragments of a basal surface may represent a second species in which the base is feebly rounded and a single spiral lies just within the periphery. The umbilicus is scalar, and the umbilical margin acutely angulated. Only the incrementals sculpture the inner umbilical margin of the whorl.



*Architectonica* sp.

(Plate 14, figures 15, 18)

*Architectonica nobilis* (Bolten) Roeding (= *Solarium granulatum* Lamarck), probably the most abundant of the "sun-dials" from Hatteras to the West Indies and in the Gulf of Mexico, is preceded in the Eocene by a group of smaller but similarly sculptured shells that includes *Architectonica bellastrata* Conrad, described from Jackson, Mississippi, and *A. amoena* Conrad, described from the Gosport sand at Claiborne, Alabama. A few varietal forms were recognized later, but probably the small Mexican shell that has been figured should not be included under any of them. It is, however, more closely related to *bellastrata*, in which, as Palmer observed, the marginal rib is simple, rather than to *amoena*, in which the rib is dissected by a deep groove. The oblique, retractive, puckery riblets are strongest near the posterior suture, but in the figured individual, which probably is not fully mature, they persist to the periphery of the whorl. The deep channeling of the sutures is one of the characters that set it apart from other members of the *bellastrata* group.

DIMENSIONS OF FIGURED SPECIMEN: Height, 4.0 millimeters; diameter, 8.8 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 497112 from U.S.G.S. sta. 13454 (H-15), Carlos Cantú, Nuevo León.

This is one of the few individuals of *Architectonica* occurring in the basal part of the Laredo formation.

Section *Stellaxis* Dall

1892. *Stellaxis* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, pp. 323, 326.

TYPE, BY ORIGINAL DESIGNATION: *Solarium alveatum* Conrad. Claiborne of the Gulf Province.

"Section *Stellaxis*; shell with the umbilicus scalar; umbilical rib thread-like; umbilical carina coarsely toothed; sculpture strong, not granular, sparse especially above; periphery carinate and strongly marginate. Type *S. alveatum* Conrad." Dall, 1892.

*Architectonica alveata* Conrad

(Plate 14, figures 17, 20, 21, 23)

- Aug. 1833. *Solarium alveatum* CONRAD, Fossil shells of the Tertiary formations of North America vol. 1, no. 3, p. 31.  
 Dec. 1833. *Solarium bilineatum* ISAAC LEA, Contributions to geology, p. 119, pl. 4, fig. 106.  
 1835. *Solarium alveatum* CONRAD, Fossil shells of the Tertiary formations of North America, vol. 1, no. 3, p. 47, pl. 17, fig. 3. (Republication with plates)  
 1865. *Architectonica alveata* CONRAD, Am. Jour. Conchology, vol. 1, p. 29.  
 1890. *Solarium alveatum* Conrad. DE GREGORIO, Annales Géologie et Paléontologie, 7 livr., p. 133, pl. 12, figs. 13-19.  
 1892. *Solarium alveatum* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, pp. 323, 326.  
 1915. *Solarium alveatum* Conrad. COSSMANN, Essais paléoconchologie comp., vol. 10, p. 168, figs. excluded.  
 1937. *Architectonica alveata* Conrad. PALMER, Bull. Am. Paleontology, vol. 7, p. 173, pl. 19, figs. 8-13, ?14, 15, 16; ?17; ?18.

"Shell discoidal, smooth, with two revolving striae near the sutures; periphery of the body whorl acutely carinated; beneath obscurely striated, with an elevated carina and groove near the periphery; umbilicus with conical denticulations. Diameter  $\frac{5}{8}$  of an inch.

"Locality, Claiborne, Ala.

"Conrad, 1833.

"Its simple and sturdy sculpture, stellate umbilicus with spirally striate walls, carrying a single, more elevated, fine, undulate thread, nearly smooth surface and sharply marginate base cannot be mistaken. The chief variations are due to the presence or absence of the two faintly impressed lines behind the suture on the spire. It is from the Eocene of Claiborne and Clark[e] Co., Ala.; Jackson, Miss.; Creole Bluff, La.; Gonzales, Texas, and Orangeburg, S. C. *S. cognata* Gabb, from the Téton Eocene of California, belongs near this group, if the figures are to be trusted." Dall, 1892.

Stewart, 1927, refigured the Gabb species and cited its occurrence in the Domengine of the Simi Valley, presumably a time equivalent of the Claiborne.

Mrs. Palmer has designated as the lectotype of *A. alveata* the largest of the four specimens in the Conrad type material. She writes, "it is a gerontic, smooth specimen which is what Conrad repre-



sented by his figures. He described the two revolving lines near the periphery of less mature specimens."

The spiral lines might reasonably be more persistent on the lower Claiborne species than on the Jackson, and there seems to be a tendency toward such a variation. *Architectonica alveata* is more widely distributed south of the Rio Grande than it is north of it, but it is missing from the basal Laredo. The specimen figured in the Palmer report from Smithville, Texas, seems more widely umbilicate than true *alveata*.

**DIMENSIONS OF FIGURED SPECIMENS:** Height of larger individual, 12 millimeters; height of smaller individual, 9 millimeters. Diameter of larger individual, 19.5 millimeters; diameter of smaller individual, 16.5 millimeters.

**LARGER FIGURED SPECIMEN:** U. S. Nat. Mus. 497110; smaller figured specimen, U. S. Nat. Mus. 497109.

Locality of larger figured individual, U.S.G.S. sta. 13504 (M-8) from the lower or middle part of the Jackson formation; locality of smaller figured individual, U.S.G.S. sta. 13643 (M-25) from the middle part of the Laredo formation.

**DISTRIBUTION:** Laredo formation: middle Laredo; U.S.G.S. sta. 13986 (G-2); U.S.G.S. sta. 13985 (G-2); U.S.G.S. sta. 13772 (G-3); U.S.G.S. sta. 13861 (H-4); U.S.G.S. sta. 13984 (H-6); U.S.G.S. sta. 13800 (H-9); U.S.G.S. sta. 13567 (H-11); U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. 13566 (H-12); U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13643 (M-25); U.S.G.S. sta. 13639 (M-25). Jackson formation: lower or middle Jackson, U.S.G.S. sta. 13504 (M-8).

#### Section *Granosolarium* Sacco

June, 1892. *Granosolarium* SACCO, I Molluschi dei terreni Terziarii del Piemonte e della Liguria, part 12, p. 59.

Dec., 1892. *Solariaxis* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, pp. 323, 324.

**TYPE, BY ORIGINAL DESIGNATION:** *Solarium millegranum* Lamarck. Middle and upper Miocene of the Piedmont of Italy.

Dall designated the Eocene species *Architectonica elaborata* as the type of his *Solariaxis* and characterized it as follows:

"Section *Solariaxis*: shell with the umbilicus scalar, the umbilical wall with a rib between the umbilical carina (or basal margin of the umbilicus) and the suture above; the umbilical carina annulate; sculpture, except lines of growth, exclusively spiral, the spirals linear or granular; periphery rounded or sharp, with a feeble margination or none."

*Granosolarium* differs from *Architectonica*, s. s., in the development of an umbilical rib and in the more elaborate ornamentation.

#### *Architectonica josephi* Gardner, n. sp.

(Plate 14, figures 19, 22)

Shell of moderate dimensions, shaped like a small, low bee hive, with a feebly rounded profile uninterrupted at the sutures and a narrow subacute periphery. About 7 whorls, the visible protoconch paucispiral, including apparently little more than a single smooth turn, slightly bulbous and dipping inward at the apex. Later whorls converging at an angle of about 90°; the apical angle of the earlier whorls slightly greater. Suture line distinct, impressed, made inconspicuous by the strong beaded spiral on its anterior margin. Entire apical surface of conch spirally beaded. Spirals about 5 to the whorl on the holotype and topotypes, equal and equally spaced in the juveniles; on the adults, the anterior and the posterior spirals the most prominent and the most strongly beaded; spiral directly in back of the anterior spiral almost as prominent, the two remaining spirals subequal and less strongly beaded than the other three. Incrementals which bead the spirals strongly retractive. Periphery similarly beaded and sharply rounded. Base compressed at the periphery, inflated slightly away from it, strongly lirate; the remaining characters of the base, the aperture, and the umbilicus concealed by breakage or by a matrix that cannot be removed. Umbilicus apparently small, and the umbilical keel probably serrate.



**DIMENSIONS OF HOLOTYPE:** Height, 9.0 millimeters; diameter, 16.5 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 497113.

**TYPE LOCALITY:** U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S.7° 30' E. of Ciudad Camargo, Tamaulipas. Lower or middle part of Jackson formation.

*Architectonica josephi* is referable to the *elaborata* group, but the sculpture pattern is more regular than in the Claiborne topotypes, the shell smaller, and the growth more uniform. The shells in the federal collection which most closely resemble the Mexican species are two immature forms from Moodys Branch near Jackson, Mississippi, labeled "*elaborata* var." A fragment of a lower Claiborne shell, U. S. Nat. Mus. 497111, is shown in Figure 16 of Plate 14. It bears a strong general resemblance to *josephi* but differs in sculpture detail.

I have the pleasure of naming this species in honor of the former Ambassador of the United States to Mexico, the Hon. Josephus B. Daniels.

#### *Architectonica acuta* Conrad

1854. *Architectonica acuta* Conrad, in WAILES, Rept. agriculture and geology of Mississippi, p. 289 (name only), pl. 17, figs. 1a, 1b (descriptions of pls. 16 and 17 interchanged).  
 1855. *Architectonica acuta* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., 1st ser., vol. 7, p. 261.  
 1892. *Solarium acutum* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 324.  
 1937. *Architectonica (Granosolarium) acuta* Conrad. PALMER, Bull. Am. Paleontology, vol. 7, p. 167, figs. excluded.

The lower Claiborne specimens from Louisiana and Texas which Palmer has beautifully figured on Plate 20, figures 12, 14 to 17 of her Bulletin, seem to differ slightly in sculpture detail from our topotypes. The original figure published in the Wailes report is not good. In the Mexican collections a single weathered individual from U.S.G.S. sta. 14009 may help to establish the group in the upper Jackson of the western Gulf region.

Both Dall and Palmer considered the lower Claiborne Cook Mountain species, *Architectonica meekana* Gabb, as a sculpture variant of the Jackson form. Gabb's type (Plate 23, figures 4-6) kindly photographed by William T. Clarke, Jr., is No. 13291 in the collections of the Academy of Natural Sciences in Philadelphia. The protoconch of the holotype is smooth and includes a little more than a single visible turn. There are slightly more than 3 conchal whorls, all closely beaded. The umbilical surface is less finely sculptured, and the umbilical funnel is wide and open. *Architectonica meekana* Gabb may be represented by a crushed specimen from the lower Laredo formation, at U.S.G.S. sta. 13564 (H-12), but the diagnostic feature of the Texas species, the beaded threadlet introduced between the outer and inner umbilical cord, is obscured by the matrix.

#### Suborder TAENIOGLOSSA

##### Superfamily CERITHIACEA

##### Family TURRITELLIDAE

The large and important group of the early Tertiary Turritellas has been studied independently (Bowles, Edgar, *Eocene and Paleocene Turritellidae of the Atlantic and Gulf Coastal Plain of North America*, Jour. Paleont., vol. 13, pp. 267-336; pls. 31-34, 2 tables, May, 1939.)

#### Genus *Turritella* Lamarck

##### *Turritella subgrundifera* Dall

1892. *Turritella subgrundifera* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 313, pl. 22, fig. 23.

**HOLOTYPE:** U. S. Nat. Mus. 113440.

**TYPE LOCALITY:** U.S.G.S. sta. 2214, Ten Mile Creek, 1 mile west of Bailey's Ferry, Calhoun County, Florida.

The material from the Guajalote formation is in the form of interior molds and impressions of the exterior from which excellent squeezes can be taken. The adult sculpture is not separable from that of the Chipola and Oak Grove individuals, and the good preservation justifies the specific identification.

**DISTRIBUTION:** Guajalote formation: U.S.G.S. sta. 13584 (V-29); ?U.S.G.S. 13588 (W-30).



## Family VERMETIDAE

Genus *Lemintina* Risso

1826. *Lemintina* RISSO, Histoire naturelle des principales productions de l'Europe méridionale, vol. 4, p. 114.

TYPE, BY MONOTYPY: *Lemintina cuvieri* Risso = *Serpula arenaria* Linnaeus. Recent in the Mediterranean.

The shell is tubular, irregularly coiled or twisted, and attached or free. The external surface is usually lirate and often more or less granulose. No longitudinal laminae are developed, but the tube is frequently cut up by perpendicular partitions or pouches, concave forward. The operculum is absent.

The genus is widely distributed in the warmer waters of the Recent seas.

*Lemintina?* sp.

An imperfectly preserved, closely and irregularly coiled tube, possibly referable to *Lemintina*, was recovered from the sandy shales of the upper Midway 650 meters N. 70° E. from Rancho Viejo, Nuevo León, U.S.G.S. sta. 13765 (E-18).

The genus may also be represented in the calcareous sandstones of the upper or middle Jackson at U.S.G.S. sta. 13467 (M-11), Zacate, Nuevo León.

## Family MELANIIDAE

Genus *Hemisinus* Swainson

1840. *Hemisinus* SWAINSON, Treatise on malacology, pp. 200, 341.  
 1885. *Semisinus* P. FISCHER, Manuel de conchyliologie, p. 701.  
 1892. *Semisinus* P. FISCHER AND CROSSE, Mission scientifique au Mexique et dans l'Amérique Centrale, Recherches zoologiques, pt. 7, vol. 2, p. 313.

TYPE, BY MONOTYPY: *Melania lineolata* [lineata on p. 200], Gray. Recent in the Jamaican rivers.

Shell variable in outline, elevated ovate conic or fusiform, more rarely turreted, the relative dimensions showing a wide range. Apex small and obtuse, rarely preserved. Aperture obliquely lenticular, acutely angulated posteriorly, truncate, and, in *Hemisinus* s.s., emarginate anteriorly. Outer lip thin, sharp, flaring slightly. Parietal wall glazed.

The Recent shells are operculate. The sculpture has been considered the most convenient if not the most fundamental character in the group separations. *Hemisinus* s.s. includes the smooth forms and those with a faint spiral lineation.

*Hemisinus* is of interest because of the factors governing its distribution. It is a fluviatile group and, quoting Brown and Pilsbry (Acad. Nat. Sci. Philadelphia, Proc., pp. 212-213, 1914), is dependent for existence upon running water. It is not found in intermittent and seasonal drainage but only in permanent streams. The eggs are not gelatinous and are not readily carried from one stream to another on the feet of birds. So closely is the distribution restricted by the drainage system that any anomalies in the occurrence of a given species are accepted as evidence of former drainage patterns.

*Hemisinus* is known only from tropical and subtropical America. The species in northeastern Mexico are related, apparently, to those from the middle Oligocene of Antigua. They may not have inhabited the same ancient river, but land connection during the life of their common ancestor may be postulated.

Section *Longiverena* Pilsbry and Olsson

1935. *Longiverena* PILSBRY AND OLSSON, Acad. Nat.; Sci. Philadelphia, Proc., vol. 87, p. 11.  
 TYPE, BY ORIGINAL DESIGNATION: *Hemisinus tuberculata* Spix = *Melania tuberculata* Wagner in



Spix = *Hemisinus spica* Von Ihering. Brazilian rivers in the provinces of Rio de Janeiro and Bahia.  
 "Shell with spiral cords or grooves and axial folds or ribs."  
 "Whorls rounded, shell elongate." Pilsbry and Olsson, 1935.

*Longiverena* includes a number of the later Tertiary Antillean species as well as those from Brazil.

*Hemisinus miralejas* Gardner, n. sp.

(Plate 16, figures 12, 15)

Shell small and very slender, polygyrate. Whorls narrow, rounded, constricted at the sutures, increasing slowly but regularly in diameter. Body similar in contour to the whorls of the spire. Protoconch lost in all specimens. Whorls of conch probably reaching 10 or 12 in the perfect shell, very gradually tapering to an acute apex. Sculpture of spiral threads, commonly 6 or 8, subequal and more regularly spaced on the early whorls than on the later, intersected by numerous arcuate axials varying widely in degree of prominence, more or less incremental in character, and forming with the spirals a reticulate sculpture pattern. Base of the body adorned with about 4 lirations and, between the anterior of these and the fasciole, a space sculptured with only growth lines. Aperture rather broad. Outer lip thin and following the sinuous outline of the incrementals. Inner lip washing the body wall, thickened and reverted slightly in front, and margined by a crescentic umbilical groove. Anterior extremity of aperture slightly flattened.

DIMENSIONS OF IMPERFECT HOLOTYPE: Height,  $15.3 \pm$  millimeters; diameter, 7 millimeters. Dimensions of imperfect paratype: Height,  $15.3 \pm$  millimeters; diameter, 6 millimeters.

TYPE MATERIAL: Holotype, U. S. Nat. Mus. 495099; paratype, U. S. Nat. Mus. 495100.

TYPE LOCALITY: U.S.G.S. sta. 13539 (N-17).

*Hemisinus miralejas* is very common in the siliceous beds at the base of the upper middle Oligocene sandstone of Carlos Cantú. There is a wide variation in the sculptural detail, and more than one species may be represented. In the mode and abundance of its occurrence *Hemisinus miralejas* suggests the middle Oligocene Antillean species, *Hemisinus antiguensis* Brown and Pilsbry, but that species has a higher apical angle and a more produced body whorl.

DISTRIBUTION: Ashy sandstone at the base of upper middle Oligocene: U.S.G.S. sta. 14023 (N-13) and U.S.G.S. sta. 13539 (N-17).

*Hemisinus siliceus mexicanus* Gardner n. subsp.

(Plate 16, figure 13)

Cf. 1914. *Hemisinus siliceus* BROWN AND PILSBRY, Acad. Nat. Sci. Philadelphia, Proc., vol. 66, p. 211, pl. 9, fig. 2.

Cf. 1919. *Hemisinus siliceus* Brown and Pilsbry. COOKE, Carnegie Inst. Washington, Pub. 291, p. 119, pl. 3, fig. 3.

The shell is polygyrate, the spire high and evenly tapering. There are six whorls in the imperfect holotype, which probably includes all but the nuclear turns. The protoconch must have been very small, much smaller than that of the Recent West Indian *Hemisinus cubanianus* D'Orbigny. The whorls of the conch are closely appressed and sculptured only with microscopically fine growth striae which are feebly sigmoidal on the body and bent backward a little upon the spire. Traces of an even fainter spiral lineation may be detected on a fresh surface. The growth lines indicate that the outer lip was arched forward. The aperture is angulated posteriorly and weakly pouting in front. The inner wall is oblique and washed with callus. There is a feeble thickening at the base of the pillar, but the growth lines round rather smoothly into it.

DIMENSIONS OF HOLOTYPE: Height, 26 millimeters; diameter, 10 millimeters.

HOLOTYPE: U. S. Nat. Mus. 496014.

TYPE LOCALITY: U.S.G.S. sta. 13539 (N-17), east slope of hill on old road which crosses Miralejas-Cojita road 1829 meters south of Rancho Miralejas, Carlos Cantú, Nuevo León. Ashy sandstone at base of upper middle Oligocene sandstone.

The subspecies differs slightly from *H. siliceus* Brown and Pilsbry, s.s. The whorls of the conch are narrower and, judging from the topotypes, more numerous in the Mexican form, the protoconch



is smaller, and the incremental sculpture less distinct. These differences may not be of taxonomic value, but an identity of species would imply a land connection for which there is no other evidence.

### Family CERITHIIDAE

#### Genus *Texmelanatria* Palmer

1937. *Texania* PALMER, Bull., Am. Paleontology, vol. 7, no. 32, p. 181. Not *Texania* Casey, Washington Acad. Sci., Proc., vol. 11, p. 84, 1909. (Coleoptera.)  
 1942. *Texmelanatria* PALMER, Jour. Paleontology, vol. 16, no. 5, p. 674 (replacement name).

TYPE, BY ORIGINAL DESIGNATION: *Cerithium texanum* Heilprin. Laredo formation of Texas and northeastern Mexico.

The genus presents a slender, fairly heavy, multispiral shell of moderate or large dimensions; the whorls are high and flattened laterally, and the later whorls are compressed in front of the suture. The blunt ribs do not increase in number toward the aperture but are more distant on the later whorls. In the genotype, neither spirals nor peripheral spines are developed. The specimens figured by Palmer from Louisiana and from the Brazos do not agree with our probably topotypic material and may represent another group entirely. The characters of the aperture are not well known. No indication of a posterior canal has been observed, and the anterior canal is reduced to a short, shallow spout. The body callus is rather heavy, and the outer margin sharply defined. The genotype is fairly common in Manados Creek about half a mile above its mouth on the Rio Grande in Webb County north of Laredo.

The genus was introduced into the family Melanopsidae, and the replacement name suggests a close relationship to *Melanatria* Bowdich described from a species with coronal spines living in the rivers of Madagascar. The associates of the genotype of *Texmelanatria* are all marine. The evidence offered for the reference of "*Cerithium*" *texanum* Heilprin to a family of dominantly fresh-water shells seems inconclusive, and the genus is retained in the large and ill-defined family of the Cerithiidae.

#### *Texmelanatria* sp. cf. *T. texana* (Heilprin)

(Plate 17, figure 19)

Synonymy and description of *Texmelanatria texana* (Heilprin):

1891. *Cerithium texanum* HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc., pp. 401, 404, pl. 11, fig. 2.  
 1937. *Texania texana* (Heilprin). PALMER, Bull. Am. Paleontology, vol. 7, no. 32, p. 182, pl. 21, figs. 16, 21?, 22?, 23?.

"Shell turreted, of the type of the well-known *Cerithium giganteum* and *C. Parisiense* of the Paris Basin, but more rapidly tapering; whorls ? in number, smooth, moderately convex, and ornamented with obtuse, widely placed and slightly diagonal ribs, which completely traverse the whorls; aperture?"

"Station 5, Rio Grande. Two fragments, lacking both apex and aperture, and measuring about one and a half inches in height. Although thus imperfect, I have thought best to describe the form, as it represents a well-recognized type from the European Eocene deposits which has not heretofore been generally recognized as occurring in the United States. The species is most nearly related to *Cerithium Parisiense*, of Deshayes, from which it differs in the rapidly-tapering spire." Heilprin, 1891.

The description is inadequate, and the figure crude and incomplete, but Heilprin's name has been associated in the literature with a tall slender "cerite" rather widely distributed in the Rio Grande embayment. His figure indicates a less slender shell, and the broader outline is further emphasized by his comparison to *Cerithium parisiense* of Deshayes "from which it differs in the rapidly tapering spire". The chances are that Heilprin had before him Deshayes' excellent figure published in the *Animaux sans vertèbres*, vol. 2, pl. 76, fig. 1, Paris, 1866. Deshayes' figure indicates a shell with an apical angle midway between that of Heilprin's figured specimen and the common "cerite" of the upper part of the Laredo formation which varies little in relative proportions. Heilprin's type has



not been examined, but neither his figure nor his description seems to justify the use of his name for the slender shell. A mold (U. S. Nat. Mus. 497131) of the same general proportions as that indicated by Heilprin's figure but with the ribs very much worn down was recovered from the upper Laredo sandstones at U.S.G.S. sta. 13945 (H-3) in the vicinity of Mier. The estimated height of the form represented by the mold in question is 90 millimeters, the greatest diameter, 33 millimeters, the apical angle, not far from  $35^{\circ}$ .

However, these 2 whorls alone do not establish the species for, in south Texas, *T. texana* has been found only in the lower Laredo, and a more complete quota of shell characters is needed to extend its range to the upper Laredo. A new species has been based on the smaller, more slender forms with a fortuitous spiral sculpture; these are rather widely scattered through the upper Laredo in the Mier sector.

*Texmelanatria angeloi* Gardner, n. sp.

(Plate 17, figure 20)

1892. *Goniobasis? texana* (Heilprin). DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, pp. 277, 286.  
1895. *Goniobasis texana* (Heilprin). ALDRICH, Bull. Am. Paleontology, vol. 1, no. 2, p. 14, pl. 2, fig. 3.  
*Cerithium texanum* Heilprin of authors.

Shell rather large, multispiral, the whorls laterally compressed and gradually tapering at an angle that probably does not exceed  $25^{\circ}$ . Body whorl only a little larger and higher than the latest whorl of the spire, abruptly constricted basally. Exact number of whorls not known, probably about 12. Tip decollated in all material. Axial costae narrow, sharply pinched on the early whorls, broader and more undulating on the later, 7 or 8 to the whorl, not increasing in numbers and consequently more closely spaced upon the early whorls, continuing to the posterior suture on the early whorls, but in the later, inclined to die out on the obscure shoulder with some tendency toward peripheral nodes on the body. Four spirals on the later whorls of a form that is probably not fully adult, the anterior of the 4 barely visible behind the suture. Whorls closely appressed, the posterior margin creeping back a little upon the preceding volution, the suture line distinct. Characters of body and aperture imperfectly known. Some indication of spiral threading on the base of the body. Aperture short, the outer lip not preserved, probably constricted anteriorly into a short spout.

DIMENSIONS OF IMPERFECT HOLOTYPE: Estimated height, 60 millimeters; diameter 19 millimeters.  
HOLOTYPE: U. S. Nat. Mus. 497130.

TYPE LOCALITY OF HOLOTYPE: U.S.G.S. sta. 13987 (H-3), at pass of Rio Alamo and Mier-Parás road, Mier, Tamaulipas. Upper part of the Laredo formation.

This is the form commonly cited under "*Cerithium texanum* Heilprin" and rather widely distributed in the lower Laredo of south Texas. Heilprin's figure covers only 3 whorls, but both his figure and his text indicate a more rapidly tapering spire than that of *Texmelanatria angeloi*. Dall referred Heilprin's species to *Goniobasis*, and both Dall and Aldrich cite it from Wheelock, Texas. The young form figured by Aldrich is probably distinct, and although the characters of the aperture are imperfectly known it seems highly improbable that the species should be referable to the melanids, an important group of fresh-water and brackish-water shells. The fauna associated with *T. angeloi* is consistently marine. The species, excepting for a few fragments, is represented by molds only, but these have a fairly wide distribution through the Embayment.

A closely related form which may be conspecific with that reported from Wheelock and Lee counties under the name of *Cerithium texanum* is represented on the Sabine River. Our Sabine River material is fragmentary, but it indicates a shell with more laterally compressed and trapezoidal whorls and costals which do not tend to die out near the posterior suture but are persistent, opposite, and so arranged that they form slightly protractive flutings that extend at least from the medial portion of the spire to the base of the body. Four strong spirals gird the base of the Sabine River form, and similar spirals are obscurely indicated upon the holotype of *angeloi*.

The Sabine River species may be an ancestral form of *T. angeloi*. It comes, probably, from not more than 50 feet above the base of the Laredo formation and is associated with *Corbula texana* Gabb. *Texmelanatria angeloi* has been reported from the upper Laredo formation alone.



DISTRIBUTION: Laredo formation: upper Laredo, U.S.G.S. sta. 13987 (H-3); U.S.G.S. sta. 13943 (H-3); U.S.G.S. sta. 13958 (H-3); U.S.G.S. sta. 13945 (H-3); U.S.G.S. sta. 13947 (H-3); U.S.G.S. sta. 13948 (H-3).

Genus *Cerithium* Bruguière

1789. *Cerithium* BRUGUIÈRE, Encyclopédie méthodique histoire nat., vol. 1, p. XV.

TYPE, BY TAUTONOMY: *Cerithium adansonii* Bruguière (= "le cerite" of Adanson). Recent off the coast of west equatorial Africa.

Shell large or small. Spire high and many-whorled; the body short, contracted abruptly into a short, slightly oblique canal. Protoconch small, pauci-spiral, not sharply delimited. Spiral sculpture the first to appear, later, the commonly ornate axial sculpture; and, at their intersection nodes of greater or less prominence. Aperture moderately large, obliquely ovate, commonly notched posteriorly and contracted anteriorly into a short canal. Columella twisted. Parietal callous heavy.

*Cerithium* is one of the many well-known names with an uncertain title. The question of the authenticity of the type is still under discussion, and until a definite decision has been reached the continued use of the long-established name may perhaps be permissible.

*Cerithium revillense* Gardner, n. sp.

(Plate 17, figures 22, 23)

Shell moderately large and heavy, coarsely sculptured. Spire incomplete in all the abundant specimens, the apical angle apparently offering a wide range of variation. Number of whorls preserved, rarely more than 5 or 6, probably at least half as many more in the lost portion. Protoconch not preserved. Early part of the shell evenly conic, the later whorls tabulated by the prominence of the posterior spiral. Sculpture coarse and remarkably uniform; whorls of the spire wound with 4 strong cords, equal and equispaced on the earlier whorls, the posterior cord becoming increasingly strong and nodose upon the later volutions; suture revolving on a fifth spiral which becomes apparent in the old shells; base of the body corded with 4 to 6 additional spirals similar in character to those on the preceding turns. Early whorls rippled with about 10 riblets which on the adult are evident only in the nodes of the posterior spiral and an inconstant undulation on the rest of the whorl. Suture line inconspicuous. Aperture incomplete in all the many specimens, angulated posteriorly; the outer lip almost vertical along the side of the body, rounding rather abruptly at the base; anterior extremity of aperture probably a short narrow spout.

DIMENSIONS OF HOLOTYPE: Estimated height, 38 millimeters; diameter, 14 millimeters.

DIMENSIONS OF PARATYPE: Estimated height, 38 millimeters; diameter, 16 millimeters.

TYPE MATERIAL: A holotype, U. S. Nat. Mus. 495012, and a paratype, U. S. Nat. Mus. 495013, both with early whorls missing and apertures incomplete.

TYPE LOCALITY: U.S.G.S. sta. 13228, banks of the Rio Salado at Guerrero, Tamaulipas. Lower part of the Mount Selman formation.

Before the Spanish occupation the settlement of Guerrero was known as "Revilla".

Although *Cerithium revillense* is extraordinarily abundant at the type locality it is not represented in any other of our numerous collections. In the Gulf province, as far east as western Alabama, *Cerithium vinctum* Whitfield (Plate 14, figures 3, 7) of similar dimensions but unlike in sculpture pattern occurs near the top of the Mount Selman.

*Cerithium? alejandroi* Gardner, n. sp.

(Plate 18, figures 7, 8, 9, 12, 13)

Shell rather small, moderately slender, acutely tapering. Early whorls decollated on all available specimens, probably close to 15 in perfect shells; whorls of spire vaguely pagodiform, the anterior spiral overhanging the suture and carinating the whorl, which is obliquely flattened behind it. Body comparable in width to the whorls of the spire but rounded rather than angulated. Sculpture reticulate, the surface of the whorl blocked off into a series of squarish or rectangular depressions by the numerous narrow axials, which at the intersection with the spirals are sharply noded; spirals 3 to the whorl, the anterior the most prominent, outlining the periphery, and overhanging the suture; the posterior spiral following close in front of the suture line, the medial spiral midway between the



two; posterior margin of the suture raised into a rounded thread; apertural characters not well preserved in any individual.

**DIMENSIONS OF HOLOTYPE:** Height, 34 millimeters; greatest diameter, 13 millimeters.

**DIMENSIONS OF INCOMPLETE PARATYPES:** Height of incomplete specimen (3 whorls) figured to show fully adult sculpture, 15 millimeters; greatest diameter, 12 millimeters. Height of incomplete specimen (4½ whorls) figured to show normal adult sculpture, 18.5 millimeters; greatest diameter, 10 millimeters. Height of nearly complete specimen, probably immature, 19 millimeters; greatest diameter, 7.5 millimeters.

**TYPE MATERIAL:** Holotype, U. S. Nat. Mus. 496442; three paratypes, U. S. Nat. Mus. 496443.

**TYPE LOCALITY,** both for holotype and the three paratypes: U.S.G.S. sta. 13496. Yegua formation.

*Cerithium? alejandroi* is named in honor of Alejandro Prieto, the distinguished author of the *Historia de Tamaulipas*.

The species displays one of the sculpture patterns most common among the cerites, but no Claiborne form has been noted to which it shows any marked relationship. A chara fruit adhering to one individual, U. S. Nat. Mus. 497133, is indicative of the shallow water in which the species flourished. Its abundance indicates exceptionally favorable ecologic conditions.

**DISTRIBUTION:** Yegua formation: U.S.G.S. sta. 13496(I-4); U.S.G.S. sta. 13966 (J-7).

*Cerithium? sp. cf. C.? alejandroi* Gardner

(Plate 18, figures 10, 11)

Specimens from the Yegua formation at U.S.G.S. sta. 13966 (J-7), 2 kilometers S. 41° W. from Rancho Las Garcias, about 25 kilometers south of Roma (U. S. Nat. Mus. 496444, figure 11), taper a little more acutely than the usual form from the type locality, but the sculpture pattern is entirely similar, and the forms are probably referable to *C. alejandroi*. The height of the specimen is 16.5 millimeters; the greatest diameter, 7 millimeters.

Another individual (U. S. Nat. Mus. 496445, figure 10) associated with the type material at U.S.G.S. sta. 13496 (I-4) exhibits differences which are probably of taxonomic significance. The axials are closer and sharper than in the normal *alejandroi*; the spirals, particularly the anterior, are relatively less prominent, and the nodding at their intersections less conspicuous. The incomplete specimen of 4 whorls is 18 millimeters high, and the greatest diameter is 9.5 millimeters. Further material is necessary for adequate identification.

*Cerithium* sp.

Incomplete cerites with numerous narrow whorls, and numerous narrow, protractive axials overridden by the spiral lirae are common in the lower Oligocene at U.S.G.S. sta. 14056 (M-12). A related species with wider, more prominent spirals and less regular axials reduced to little more than a series of nodes at the posterior suture is recorded at U.S.G.S. sta. 14023 (N-13) from the ashy beds at the base of the upper Middle Oligocene sandstone.

*Cerithium hillsboroense* Heilprin

(Plate 19, figure 11)

1887. *Cerithium hillsboroensis* HEILPRIN, Wagner Free Inst. Sci., Trans., vol. 1, p. 124, pl. 8, fig. 67.  
 1892. *Potamides hillsboroensis* (Heilprin). DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 286, pl. 15, fig. 12.  
 1915. *Potamides hillsboroensis* (Heilprin). DALL, U. S. Nat. Mus., Bull. 90, p. 91, pl. 8, fig. 5.

"Shell elevated, of ten or more volutions; sutures impressed; whorls ornamented with four clearly-defined lines of granulations, the granulations of the top series very large, prominent, and somewhat in the form of tubercles; those of the second line very minute; moniliform and nearly equal on the third and fourth lines, in some cases those of the third line most prominent, in other cases the reverse; surface covered with longitudinal, curved creases; base depressed, with some four or five revolving lines; aperture?

"Length, 1.5 inch.

"Of the type of the European *Cerithium elegans*, but the moniliations on the lower lines of the whorls are direct, and not oblique, and the number of such lines is also different; the upper granulations are, in addition, comparatively more prominent.



"Very abundant in the rock forming the bed of the Hillsboro River, which is the first example in this country of a true *Cerithium* bed." Heilprin, 1887.

The Mexican forms retain no characters by which they can be separated from the species from Ballast Point, Florida. The spirals are more spinose than those of *mendezense*, and the ornamentation of the anterior and posterior spirals more nearly similar. The number of intermediate spirals is reduced to 1 or 2, although a slight increase in age in both species is usual. The aperture is lost on all *C. hillsboroense* in the collections from Mendez. The figured specimen is U. S. Nat. Mus. 494965 from U.S.G.S. sta. 13579 (P-25).

The age, determined largely from the field evidence, is upper Oligocene.

*Cerithium mendezense* Gardner, n. sp.

(Plate 19, figures 7-9)

Shell of medium dimensions, elevated, many-whorled. Protoconch and all but the final 3 whorls of the conch lost. Outline of remaining whorls trapezoidal, blurred by the sculpture. Directly in front of the suture a heavily noded spiral; nodes averaging 12 or 13 to the whorl, prominent, rounded, undulatory, and resembling the extremities of obscure axials; 3 subequal, wavy, and beaded lirae in front of the noded spiral; a little behind the anterior suture, a spiral beaded more strongly and more regularly than the 3 behind it, the number of the beads on this liration in the holotype more than double those of the nodes on the posterior spiral; suture following a fourth very fine lira; this sutural spiral on the final whorl outlining the periphery and approximately equal in strength to that behind it; an almost equally strong and beaded basal spiral in front of it; 3 finer, wavy spirals on the flattened portion of the base. Incremental sculpture strong and laminar, especially on the base and on the final half whorl. Aperture subquadrate; outer lip bent sharply at the periphery. Labrum very much thickened and dentate within; labral margin relatively thin and flaring, produced backward slightly on the preceding whorl; opening obliquely lenticular. Anal extremity partially closed by a rather heavy cord on the apertural wall opposite the elongated denticle on the inner margin of the labrum. Anterior extremity produced into a short, sinistrally twisted spout with proximate parallel margins.

DIMENSIONS OF IMPERFECT HOLOTYPE: Height, 20 millimeters; greatest diameter, 12.8 millimeters; diameter at right angles to greatest diameter, 10.9 millimeters.

HOLOTYPE: U. S. Nat. Mus. 494961.

TYPE LOCALITY: U.S.G.S. sta. 13579 (P-25), 5 kilometers N. 21° W. of Mendez, Tamaulipas. Limestone of upper Oligocene age.

The incomplete spire (fig. 8) from the same locality is U. S. Nat. Mus. 497259.

*Cerithium mendezense* differs from *C. hillsboroense* Heilprin in sculptural detail. The posterior spiral of the Heilprin species is sharply spinose, whereas the nodes of *C. mendezense* are bluntly rounded. The anterior spiral of *C. hillsboroense* is more sharply beaded or noded, and there are fewer spirals developed on the intermediate area. In the photographs, the Floridian species seems much more slender, but there is a marked variation in this feature.

None of the restricted groups of cerites have been found which will accurately include this genus. The spiral cord on the base of the body wall within the aperture is similar to that of *Cerithium nodulosum* Bruguière, formerly cited as the type of *Cerithium*, and the anterior canal, though very short, is something more than the notch of *Potamides*. The species has been recognized only at the type locality, which from the field relations seemed to be included in beds of upper Oligocene age.

*Cerithium* sp.

Numerous molds of an indeterminate species probably referable to *Cerithium*, s. l., were recovered from the sandy Oligocene limestones at U.S.G.S. sta. 13579 (P-25) near Mendez. The whorls are higher, relatively, than in most of the cerites, the axials are low and rippling with an occasional varicose rib and were probably overridden by flattened spirals. This abundant form may be later recovered in a determinable state.

Subgenus *Ochetoclava* Woodring

1928. *Ochetoclava* WOODRING, Carnegie Inst. Washington, Pub. 385, p. 334.



TYPE, BY ORIGINAL DESIGNATION: *Cerithium gemmatum* Hinds. Recent from the Gulf of California to Panama. Reported from the Pleistocene of Magdalena Bay, Lower California.

"Shell medium-sized, slender. Body whorl bearing a varix opposite outer lip, other whorls varicose at intervals. Aperture ovate. Anterior canal relatively short, oblique, deep, curved backward, unemarginate. Columella bearing a basal twist and a median fold. Edge of inner lip detached along pillar bearing an obscure sinus at top of pillar. Outer lip ascending, forming a long narrow posterior channel. Interior of outer lip furrowed. Sculpture consisting of spiral bands bearing nodes or beads.

"The shorter and less horizontal canal and strongly ascending outer lip, which produces a long posterior channel, separate *Ochetoclava* from *Clava* s.s. All the American fossil and living species fall in *Ochetoclava*. This subgenus is represented in the Miocene deposits of Florida and the Caribbean region, and even in the Pliocene of Florida, but probably is extinct there." Woodring, 1928.

The subgenus includes a compact group of mid-American cerites of upper Tertiary age on the Atlantic side and of post-Tertiary on the Pacific.

*Cerithium (Ochetoclava)* sp. cf. *C. (O.) chipolanum* Dall

Synonymy and description of *Cerithium (Ochetoclava) chipolanum* Dall:

1892. *Cerithium chipolanum* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 285, pl. 22, fig. 7.

"Shell of the general type of *C. thomasiae* Sowerby, but small, with three very small, smooth, compact nuclear whorls and eight subsequent rounded whorls; transverse sculpture of numerous small, rounded ribs extending across the whorl, and which are relatively stronger and more irregular, though less numerous, on the early whorls; the varices are quite irregular, some being strongly marked and others feeble; spiral sculpture of three or four primary, little-elevated, flattish threads, separated by wider interspaces, in which are two to four fine secondary threads; there are no beads or nodules, but the primaries appear conspicuous where they cross the ribs; similar sculpture extends over the base; aperture not much expanded, with a moderate callus and subsutural ridge on the body, a short, recurved canal and arched pillar. Lon. of shell 10; max. diam. 4.5 mm.

"This curious little species sometimes has a flattened aspect like a *Ranella*, from the tendency of the varices to be confined to one side." Dall, 1892.

External molds of closely related but probably not specifically identical forms are rather common in the Guajalote formation in the vicinity of San Fernando. The nodes of the Mexican species seem less sharp than those of the Floridian, and there is no intercalated fillet between the noded spirals. Other cerites referable to other groups are present but too imperfect to determine or discuss.

DISTRIBUTION: Guajalote formation: U.S.G.S. sta. 13586 (V-29).

*Incertae sedis*

(Plate 18, figure 4)

Half-inch slabs of indurated sandstone packed with small gastropods, possibly cerithids, occur in the Mier section at U.S.G.S. sta. 13494 (H-3). All the observed gastropods are probably referable to the same species, and the vast majority are known only from internal molds not exceeding a centimeter in height. Vestiges of a reticulate sculpture are retained on a very few individuals and imperfectly indicate some group of the Cerithiidae. The slender, acutely tapering outline, and the narrow, rounded, numerous whorls separated by deep sutures are probably specific characters. The few associated bivalves may be identical with the species from the marls directly below the slabby sandstones at U.S.G.S. sta. 13495 (H-3).

FIGURED SPECIMEN: A fragment of a sandstone slab displaying a number of internal molds. U. S. Nat. Mus. 495018 from U.S.G.S. sta. 13494 (H-3), 2300 meters N.  $48\frac{1}{2}^{\circ}$  E. of the church tower at Mier, Tamaulipas. Yegua formation.

The horizon is near the top of a series of red and purple clays, probably comparable to those which underlie the heavy scarp-forming sandstone at Loma Blanca in Zapata County, Texas.

The same gastropods are present though in greatly diminished numbers in the bivalve zone, slightly lower in the same clay series. The bivalves indicate almost certainly a true marine fauna, but the small gastropods that pack the sands above probably indicate a shoaling of the waters and possibly a brackish facies.



Genus *Potamides* Brongniart

1810. *Potamides* BRONGNIART, Mus. Histoire Nat. Paris, Annales, vol. 15, p. 368.

TYPE, BY MONOTYPY: *Potamides lamarkii* Brongniart. Oligocene of the Paris Basin.

The genus is here used in the old loose sense for those cerites differing from *Cerithium* in the absence of a spoutlike extension of the aperture. There is a slight depression at the anterior extremity, but no formed anterior canal. The derivation of the word indicates the habitat of the group.

*Potamides? plicifera* (Heilprin)

(Plate 18, figures 5, 6)

1880. *Terebra plicifera* HEILPRIN, U. S. Nat. Mus., Proc., vol. 3, p. 151, pl. [no number], fig. 8.

1897. "*Terebra*" *plicifera* Heilprin. ALDRICH, Bull. Am. Paleontology, vol. 2, no. 8, p. 4, pl. 3, figs. 2, 2a.

1937. "*Clava*" *plicifera* Heilprin. PALMER, Bull. Am. Paleontology, vol. 7, p. 218, pl. 29, fig. 12.

"Turreted; whorls ? in number, flattened, rapidly decreasing in size from the base upwards, and ornamented by numerous broad and prominently defined plicae, having a sigmoidal flexure; an impressed line on the upper portion of each volution produces a subsutural ring or band, over which the plicae and corresponding sulci are continued, and which occasionally tends to become double from the presence of a second impressed line. Body-whorl with two elevated revolving lines on its basal angulation; base radiately and longitudinally striated; aperture? (broken in all specimens)."

"Length ? (No. 8919 [U. S. National Museum])."

"Atascosa County, Texas." Heilprin, 1880.

"Although the aperture cannot now be determined beyond a doubt, it certainly indicates a close relationship with the Cerites. If it proves to be a *Cerithium* then the specific name must be changed, for it is preoccupied." Aldrich, 1897.

Perhaps the most interesting feature of *Potamides? plicifera* is its distribution and mode of preservation. In the three areas from which it is recorded, it is invariably silicified. In some localities the ash association is obvious, in others no ash was observed. The horizon of its abundant occurrence is apparently higher in Atascosa County than it is in Zapata and Starr counties or in northeastern Mexico. In Mexico, it is prolific in a zone a little more than 100 feet below the Roma sandstone. In Starr and Zapata counties it occupies a similar horizon.

A Texas and a Mexican individual have been figured; U. S. Nat. Mus. 495011 from U.S.G.S. sta. 13788, Atascosa County, Texas, and U. S. Nat. Mus. 495010 from U.S.G.S. sta. 13497, (I-4), 9330 meters S.  $43\frac{1}{2}^{\circ}$  E. of the church tower at Mier, Mier, Tamaulipas.

These moderately slender multi-whorled silicified molds with fragments of shell and traces of an axial sculpture pattern still adhering are unmistakable even though they have lost the characters necessary for their sure generic determination.

DISTRIBUTION: Upper part of Yegua formation: U.S.G.S. sta. 13499 (I-4); U.S.G.S. sta. 13500 (I-4); U.S.G.S. sta. 13497 (I-4); U.S.G.S. sta. 13966 (J-7); U.S.G.S. sta. 14053 (L-6-L-7).

## Family LITIOPIDAE

Genus *Alaba* H. and A. Adams

1853. *Alaba*. H. and A. ADAMS, Genera Recent Mollusca, vol. 1, p. 241.

TYPE, BY SUBSEQUENT DESIGNATION (Nevill, Hand list Mollusca Indian Museum, pt. 2, p. 181, 1885): *Alaba melanura* C. B. Adams = *Rissoa melanura* C. B. Adams. Recent in the West Indies.

*Alaba* includes small, moderately slender, thin, multi-whorled shells decorated at least on the adult with relatively heavy, obtuse varices and a subordinate spiral lineation. The aperture is obliquely ovate, commonly broad posteriorly, narrow, and depressed anteriorly into an obscure spout.

At a single locality in the middle part of the Laredo formation, U.S.G.S. sta. 13643 (M-25), three individuals were collected which seem to establish the genus, though they are not specifically determinable. They have much in common with "*Pseudotaphrus*" *varicifer* Cossmann, 1894, described from Claiborne, Alabama, and may fall within the limits of variation of that species.



## Superfamily CALYPTRAEACEA

## Family CALYPTRAEIDAE

Genus *Calyptraea* Lamarck

1799. *Calyptraea* LAMARCK, Prodrôme d'une nouvelle classification des coquilles, Soc. Hist. Nat. Paris Mém., p. 78.

TYPE, BY MONOTYPY: *Patella chinensis* Linnaeus. Recent on the European Coast from the British Isles to the Mediterranean. Fossil in the Pliocene and Pleistocene.

Shell conic to trochiform. Base circular or rarely oval. Apex medial, spiral. Inner diaphragm developed analogous to inner cup of *Crucibulum* and posterior lamina of *Crepidula*. Columellar margin of diaphragm twisted to form a false umbilicus; outer margin adherent to periphery of shell; free margin convex.

The genus originated in the Cretaceous, and the distribution of the Recent representatives is world wide. The forms attach themselves to extraneous objects and are peculiarly characteristic of the inshore waters.

*Calyptraea* sp.

Indeterminate specimens of a thin-shelled *Calyptraea*, showing the characteristic swirl of the growth lines around the apex, occur in probable upper Midway at U.S.G.S. sta. 13653 (C-17) and U.S.G.S. sta. 13450 (D-19); and in the middle part of the Indio formation, 4 kilometers north of Stación Herreras (U.S.G.S. sta. 13466 (D-11), all in Nuevo León. None of the specimens are determinable, and more than a single species may be represented.

*Calyptraea* sp.

Individuals, possibly representing a small and simple species, possibly juveniles, are sparsely represented in the Laredo formation and in the Jackson. No trace of sculpture remains, only the swirl of the growth lines about the asymmetric apex. The largest specimen is less than a centimeter in diameter.

The distribution is similar to that of *Xenophora* species. It occurs in the middle part of the Laredo formation at U.S.G.S. sta. 13634 (M-24), U.S.G.S. sta. 13643 (M-25), in the upper part of the Jackson formation at U.S.G.S. sta. 13513 (M-11), and the lower marine Oligocene sandstone at U.S.G.S. sta. 13510 (M-11).

*Calyptraea* sp.

An indeterminate mold of a small calyptraeid was recovered from the yellow limestones of the Guajalote formation at U.S.G.S. sta. 13584 (V-29).

## Superfamily STROMBACEA

## Family XENOPHORIDAE

Genus *Xenophora* Fischer von Waldheim

1807. *Xenophora* FISCHER VON WALDHEIM, Museum-Démidoff, vol. 3, p. 213.

TYPE, BY SUBSEQUENT DESIGNATION (Gray, Zool. Soc. London, Proc., pt. 15, p. 158, 1847): *Xenophora laevigata* Fischer von Waldheim = *Trochus conchyliophorus* Born. Recent off the eastern coast of the United States from Hatteras to the Antilles and in the Gulf of Mexico. Fossil throughout the East Coast and Gulf Tertiary and in the Pleistocene.

Shell low, trochiform but never nacreous, imperforate or narrowly umbilicate. Whorls flattened, armored with agglutinated extraneous objects. Base subconic, or flattened with a sharp, peripheral keel. Aperture obliquely quadrilateral.

The persistence of this genus from the Mesozoic to the Recent attests the efficiency of the extraordinary device by which this mollusk protects itself.



*Xenophora* sp.

(Plate 17, figures 14, 15)

No specifically determinable individuals have been recovered from northeastern Mexico, but the genus has been recognized at several localities: in the middle part of the Laredo formation, U.S.G.S. sta. 13553 (H-15) and U.S.G.S. sta. 13643 (M-25); in the lower part of the Jackson formation, U.S.G.S. sta. 13503 (N-8); and in the upper Jackson, U.S.G.S. sta. 13520 (N-10) and U.S.G.S. sta. 13513 (M-11).

An example, U. S. Nat. Mus. 497125, from U.S.G.S. sta. 13513 is figured.

## Family APORRHAIIDAE

## Genus and species indet.

Molds probably referable to the family Aporrhaidae but not determinable either specifically or generically have been recovered from three lower Eocene localities in northeastern Mexico. Those from the Midway limestone scarp 5.5 kilometers south-southeast of Agualeguas, Nuevo León, U.S. G.S. sta. 13473 (B-6), and from the top of the fucoidal sandstone, 7600 meters east of the old church at Cerralvo U.S.G.S. sta. 13463 (B-9), are similar and very close to an unnamed genus and species in the Midway group of Texas (Univ. Texas Bull. 3301, p. 266, pl. 24, fig. 9, 1935). The specimen from a higher horizon, probably basal Indio, 1.5 kilometers from Agualeguas, about 100 meters southwest of the Agualeguas-General Treviño road, U.S.G.S. sta. 13609 (B-5), has a relatively very small and low spire and may be outside the family altogether.

## Family STROMBIDAE

Genus *Rimella* Agassiz

1841. *Rimella* AGASSIZ, in SOWERBY, Mineral conchology (German ed.), p. 137 (fide Sherborn).

TYPE, BY SUBSEQUENT DESIGNATION (Herrmannsen, Indicis Generum Malacozoorum, vol. 2, p. 397, 1848): *Rostellaria fissurella* Linnaeus. Eocene of the Paris Basin.

*Rimella texana* Harris

Synonymy and description of *Rimella texana* Harris:

1895. *Rimella texana* HARRIS, Acad. Nat. Sci. Philadelphia, Proc. for 1895, vol. 47, p. 78, pl. 9, fig. 1.  
 1927. *Ectinochilus (Macilentos) texanus* (Harris). STEWART, Acad. Nat. Sci. Philadelphia, Proc. vol. 78, p. 367, 1926 [1927].  
 1931. *Rimella texana* Harris. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 107.  
 1937. *Ectinochilus texanus* (Harris). PALMER, Bull. Am. Paleontology, vol. 7, p. 245, pl. 33, fig. 3.

"Size and general form as indicated by the figure; whorls 11; 1 exceedingly small, smooth; 2, 3, 4, 5 smooth and polished; 6, 7 faintly and finely cancellated; 8 with small longitudinal plicae crossed by minute spiral striae; 9, 10 more strongly plicate longitudinally, plicae most strongly developed midway of the whorls; body whorl plicate superiorly though not immediately below the suture; spiral striae very fine over the plicae but coarse above and very coarse below; outer lip acute below, thick and reflected above, medially forming a right angle; inner lip well defined, uniting with the outer above and forming a canal that passes up the spire rather more than half-way to the apex, recurving descends the width of a whorl or two; columella long and pointed, deflected backward.

"Localities.—Colorado River, Devil's Eye, Bastrop Co.; Brazos River, about one mile below the Milam-Burleson County line; Mosley's Ferry (Singley's collection); Collier's Ferry, Burleson Co., Tex.

"Geological Horizon.—Lower Claiborne Eocene.

"Type.—Texas State Museum." Harris, 1895.

The holotype is from Devil's Eye, Colorado River, Bastrop County, Texas.

In Texas, *Rimella texana* has been found only in the Weches member of the Mount Selman formation.

A few fragmentary specimens from the lower part of the Laredo formation at U.S.G.S. sta. 13559 (H-12) have retained no characters by which they may be separated from *R. texana* Harris. However, the determination is by no means certain.



*Rimella* sp.

(Plate 17, figures 7, 9)

A species closely related to *Rimella texana* Harris is indicated by imperfect material from a horizon distinctly higher than that in which *R. texana* occurs in Texas. The presence of fragments referable to the group at a lower horizon in the same general area indicates that *Rimella* resided in the north-east Mexican seas during a considerable part of the middle Eocene. The later Laredo individuals are rather more closely ribbed than *R. texana*, and the compressed and spirally striate area in front of the posterior suture is not developed as it is in *texana*. The individuals in question differ from *R. carli* Gardner in the less crowded ribbing and the tendency toward irregularities in the size and the spacing of the ribs on the body whorl. No trace of a stromboid notch has been retained, but the imperfection of the material may readily explain its absence.

DIMENSIONS OF IMPERFECT FIGURED SPECIMEN: Height, 24 millimeters; diameter, 7.5 millimeters. FIGURED SPECIMEN: U. S. Nat. Mus. 495014.

LOCALITY OF FIGURED SPECIMEN: U.S.G.S. sta. 13554 (I-14), Carlos Cantú, General Bravo, Nuevo León. Middle part of the Laredo formation.

The same species is probably present in the middle part of the Laredo formation at U.S.G.S. sta. 13569 (H-12), and a closely related species, also from the middle Laredo, at U.S.G.S. sta. 13567 (H-11), Doctor Cos, Nuevo León.

Subgenus *Ectinochilus* Cossmann

1889. *Ectinochilus* COSSMANN, Soc. royale Malacolog. Belgique, Annales, vol. 24, p. 91.

TYPE, BY ORIGINAL DESIGNATION: *Strombus canalis* Lamarck. Eocene of the Paris Basin.

The types both of *Rimella* Agassiz and of *Ectinochilus* Cossmann, proposed as a section of *Rimella* and later given generic rank by Palmer, come from the Paris Basin. The group is restricted in North America to the Eocene, in Europe, to the Eocene and Oligocene.

The absence of varices has been stressed as the separating character in *Ectinochilus*. This seems less important than the development of the stromboid notch in *Ectinochilus* and its absence in *Rimella*, or than the more pronounced looping of the posterior canal which in *Ectinochilus* doubles forward to the body.

The two groups seem very closely related, and with the exception of the varices the diagnostic characters may readily be lost. *Rimella texana* Harris looks more like the Paris Basin *R. fissurella* than it does like *R. canalis*, but *R. protracta*, described from the Gosport sand by Conrad as *Rostellaria*, has a well-developed stromboid notch and resembles in form and sculpture pattern the type of *Ectinochilus*.

*Rimella* (*Ectinochilus*?) *carli* Gardner, n. sp.

(Plate 17, figure 8)

A slender shell with high flattened close-ribbed whorls, recovered from the glauconitic sandstones near China, Carlos Cantú, Nuevo León, probably represents an undescribed species. The apex is lost, but 4 whorls of the spire and an almost complete body remain. The aperture is, however, filled with matrix, and its characters obscured. The ribs are narrow, rounded, feebly protractive, forming a continuous series barely interrupted at the inconspicuous sutures and averaging 20 to 25 to the whorl. On the body they continue with uniform strength and spacing to the outer lip although they disappear abruptly on the base and are replaced by about a dozen spiral lirae more crowded toward the anterior fasciole. Faint traces of a fine spiral lineation also persist in the spaces between the ribs. The posterior canal is continued backward and apparently turns on the earliest whorl preserved. The trace of its later course is lost. The labral varix is moderately heavy and smooth without. The interior of the labrum is concealed by the indurated matrix which fills the aperture. The base of the outer lip forms an arc of not far from 90°, and on it is a faint indication of a broad marginal notch. The terminal sinus is apparently deep and rather narrow.

DIMENSIONS OF IMPERFECT HOLOTYPE: Height, 18.2 millimeters; diameter, 6.6 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497123.

TYPE LOCALITY: U.S.G.S. sta. 13601, (H-16), 4.2 kilometers west of Rancho Topito, China, Carlos Cantú, Nuevo León. Lower part of the Laredo formation.



The absence of varices and the faint indication of a stromboid notch ally the species with *Ectinochilus*. The ribbing is more crowded, more regular, and more persistent on the body than in any of the described species from either the eastern or the western Gulf. It is also the only species in the western Gulf in which there is any indication of a stromboid notch. Both in *R. texana* Harris and in the subspecies *plana* the whorls are more numerous and less compressed, and the sculpture pattern much more like that of the young *Calyptrophorus* than it is in *R. carli*.

#### Genus *Calyptrophorus* Conrad

1858. *Calyptrophorus* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1857, p. 166. Not *Calyptrophorus* Cabanis, Archiv. für Naturgeschichte, vol. 13, pt. 1, p. 329, 1847.  
 1868. *Calyptrophorus* Conrad. GABB, Am. Jour. Conchology, vol. 4, p. 142.

TYPE, BY SUBSEQUENT DESIGNATION (COSSMANN, Essais paléoconchologie comp., vol. 6, p. 25, 1904): *Rostellaria velata* Conrad. Claiborne Eocene of the Gulf Province of the United States.

Conrad's name differs by only one letter from that proposed 10 years earlier by Cabanis for a hooded bird, and the two names are obviously of the same derivation (*καλύπτρα*, veil; *φορέω*, carry, wear). Cabanis specified his type, and *Calyptrophorus* is in good standing among the ornithologists, but long and general usage justifies the retention of Conrad's name *Calyptrophorus* for the malacologists. The International Commission on Zoological Nomenclature has recommended (Article 36) that "It is well to avoid the introduction of new generic names which differ from generic names already in use only in termination or in a slight variation in spelling which might lead to confusion. But when once introduced, such names are not to be rejected on this account."

*Calyptrophorus* is a spindle-shaped shell with a high, many-whorled spire tapering to an acute apex. The protoconch is small, smooth, and coiled only a few times. Both axial and spiral ornamentation are developed at least on the early whorls of the conch, but the spire is concealed in the adult by a highly glazed enveloping callus. The folds commonly unite along lateral seams, leaving, usually on the posterior face, an elliptical area bare or very thinly veiled, while the apertural surface may be padded and flattened. The flaring outer lip is thickened at the margin and abruptly constricted anteriorly, and the anterior canal is long, straight, and very slender.

The distribution of *Calyptrophorus* is interesting. It is characteristic of the Paleocene and Eocene of the New World, but it is not restricted to it. *Rostellaria palliata* Forbes, an Upper Cretaceous Indian species, seems to be closely related, but the anterior portion of the figured specimen is broken, and there is no material available for examination. *Cyclomolops vredenburgi* Douvillé, from the *Cardita beaumonti* beds, is also related though probably not generically identical. Both species seem from the photographs and descriptions to be closer to the Eocene *Calyptrophorus* of the Gulf Province than anything in the Gulf Cretaceous. *Calyptrophorus indicus* Cossmann and Pissarro is reputed to be one of the most abundant fossils in the lower Ranikot (Paleocene) of the Sind, but it has not been recognized elsewhere in the Tethyan Province. *Rostellaria houzeau* Briart and Cornet, from the Montian of Belgium, is a *Calyptrophorus* according to Cossmann, but there is no record of the genus in the Paris Basin. It has been recorded, however, from the Paleocene of Landana on the west coast of Africa and from the vicinity of Pernambuco, which is in almost the same latitude. Though apparently absent in the well-studied Eocene of the West Coast of the United States, there is, in the Negritos formation of Peru, the curious *Aulacodiscus lissoni* H. Douvillé, which Olsson has considered a subgenus of *Calyptrophorus* (Bull. Am. Paleontology, vol. 14, no. 52, p. 73, 1928) and to which Morley Davies (Tertiary Faunas, vol. 2, p. 99, 1934) refers as a "gerontic form of *Calyptrophorus*". Typical *Calyptrophorus* has been recovered from Soldado Rock, Trinidad, from all horizons of the Eocene of the eastern and western Gulf provinces, and, on the Atlantic Seaboard, as far north as Maryland and New Jersey. The abundant occurrence of the genus in Maryland does not coincide with the theory that *Calyptrophorus* may be used as an indicator of warm water. It is, however, a highly specialized form and should be a good time marker. Unfortunately, the preservation is commonly inadequate.

#### *Calyptrophorus popenoe* Gardner

(Plate 17, figure 10)

1935. *Calyptrophorus popenoe* GARDNER, Univ. Texas Bull. 3301, p. 269, pl. 24, figs. 4, 6-8.

Shell a little large for the group, and rather stout. Whorls of the spire numerous, trapezoidal, tapering rather rapidly to an acute apex. Protoconch smooth, small, acute, probably coiled three



times, not very well preserved. Both axial and spiral ornamentation developed on the spire, the axials little more than puckers along the anterior suture of the later whorls, though on the adolescent shell they traverse the whorl and are feebly arcuate and protractive. Spiral lirae fine and sharp, inclined to be irregular in size and spacing, 15 to 20 to the later whorls of the spire. A sharp incremental sculpture most distinct in the interspiral areas. Enveloping callus very heavy, the folds uniting along a seam on the apertural face, commonly leaving bare or thinly veiled an elliptical area directly behind the aperture. Body whorl large, slightly compressed, tapering rather rapidly toward the anterior canal. Anterior canal not preserved.

**DIMENSIONS:** Height of holotype, an incomplete individual, 48 millimeters; greatest diameter, 21 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 370938; paratypes, U. S. Nat. Mus. 370939.

**TYPE LOCALITY:** U.S.G.S. sta. 11754, 6 miles south of the McFarland sheep pens and 27 miles southeast of Eagle Pass, Maverick County, Texas. Upper part of the Midway formation.

*Calyptrophorus popenoe* is stouter than the species with which it is associated in the western Gulf, the axial sculpture disappears at an earlier stage in the growth of the shell, and the axials, when present, are not so sharp as those of *C. velatus* and *C. trinodiferus* and are more commonly confined to the anterior portion of the whorl.

The Mexican material is immature and fragmentary but apparently identical with that from Maverick County, Texas. The figured specimen is U. S. Nat. Mus. 497124 from U.S.G.S. station 13459, 5.5 kilometers south-southeast of Agualeguas, Nuevo León (B-6).

**DISTRIBUTION:** Midway formation: lower Midway, U.S.G.S. sta. 13463 (B-9); Midway undifferentiated, ?U.S.G.S. sta. 13490 (D-18); ?U.S.G.S. sta. 13491 (D-18); upper Midway or lower Wilcox, U.S.G.S. sta. 13487 (D-18).

#### *Calyptrophorus* sp.

Juveniles probably representing more than one species, but all with more slender spires than that of *Calyptrophorus popenoe*, occur at several localities in the lower Eocene. The relationship of these forms to *Calyptrophorus trinodiferus*, so abundant in the Tuscaloosa formation of the eastern Gulf, has not been determined.

**DISTRIBUTION:** Midway formation: Midway undifferentiated, U.S.G.S. sta. 13653 (C-17); ?upper Midway, U.S.G.S. sta. 13450 (D-19); Indio formation: lower Indio, U.S.G.S. sta. 13458 (B-10).

#### *Calyptrophorus carrizensis* Gardner, n. sp.

(Plate 17, figures 11, 18, 21; Plate 27, figure ?6)

Shell small, slender. Whorls of the conch probably about 7, those of the protoconch 4. Initial turn minute, the 3 succeeding nuclear whorls rapidly enlarging, broadly rounded and separated by incised suture lines. Sculpture initiated on earliest postnuclear whorl. Adolescent sculpture of narrow, feebly arcuate, protractive riblets averaging about 14 to the whorl and crossed by about 7 feeble, flattened, spiral threads; axial sculpture evanescent on the next to the final whorl, the spiral sculpture increasingly feeble. Adult veil produced backward. Apertural face in the type flattened; an obscure callus fold on either side and a prominent node midway between them at the rear of the shell. Anterior extremity not preserved in any specimen. Outer lip much thickened and produced backward; the callus covering a large spatulate area on the back of the 3 or 4 later whorls. Callus margins thickened and separated only by a deep groove extending in the adult from the posterior angle of the aperture (in the specimen figured) to the suture line between the third and fourth whorls; callus following the suture for a fraction of a whorl, then curving forward to the body. Body rounded and obliquely constricted to the slender pillar.

**DIMENSIONS:** Estimated height of holotype (anterior canal broken away), 16 millimeters; greatest diameter, 7.4 millimeters.

**TYPE MATERIAL:** Holotype, U. S. Nat. Mus. 495015; two paratypes, U. S. Nat. Mus. 495049, figured to show characters inadequately indicated on the imperfect holotype. A juvenile, U. S. Nat. Mus. 497262, probably conspecific, is also figured.

**TYPE LOCALITY:** U.S.G.S. sta. 13721 (E-3). Carrizo sandstone.

*Calyptrophorus carrizensis* is remarkable for its small size, relatively slender outline, flattened aper-



tural face, the callous folds on either side, and the very prominent node in the middle of the back. *Calyptrophorus trinodiferus* from the Wilcox, the nearest among the described species, is much larger, with a stouter body, and a thinner veil. The species is certainly known from only three localities, probably all of them along the strike in the Carrizo outcrop.

DISTRIBUTION: Carrizo sand: U.S.G.S. sta. 13722 (E-3); U.S.G.S. sta. 13721 (E-3); U.S.G.S. sta. 13477 (F-4).

### *Calyptrophorus velatus* Conrad

- 1833. *Rostellaria velata* CONRAD, Fossil shells of the Tertiary Formations of North America, p. 31.
- 1833. *Rostellaria Lamarckii* ISAAC LEA, Cont. geology, pp. 158-159, pl. 5, fig. 164.
- 1835. *Rostellaria velata* CONRAD, Fossil shells of the Tertiary Formations of North America, (republication), p. 38, pl. 15, fig. 5 (given erroneously in text as fig. 4).
- 1854. *Rostellaria vellata* CONRAD, WAILES, Rept. Agr. and geol. Mississippi, p. 289, (name only), pl. 15, figs. 7a, 7b.
- 1855. *Rostellaria velata* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 7, p. 260.
- 1858. *Calyptrophorus velatus* (*Rostellaria*) CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 9, p. 166.
- 1882. *Calyptrophorus Lamarckii* Lea. BRIART AND CORNET, Acad. royale sci. Belgique Mém., vol. 43, p. 5.
- 1896. *Calyptrophorus velatus* Conrad. VAUGHAN, U. S. Geol. Survey, Bull. 142, pp. 43, 50.
- 1904. *Rostellaria* (*Calyptrophorus*) *velata* Conrad. COSSMANN, Essais paléoconchologie comp., vol. 6, pp. 25-26, pl. 3, figs. 1-2.
- 1906. *Calyptrophorus velatus* Conrad. VEATCH, U. S. Geol. Survey, Prof. Paper 46, pl. 14, figs. 4, 4a, 4b.
- 1937. *Calyptrophorus velatus* (Conrad). PALMER, Bull. Am. Paleontology, vol. 7, p. 240, pl. 32, figs. 4, 6, 7, 8, 10-13.

"Shell subfusiform, longitudinally ribbed and transversely striated, but often coated more or less with a smooth, polished calcareous deposit, bounded by a deep groove running up on the spire and returning towards the base; outer lip not expanded; margin thick and reflected; length  $1\frac{1}{2}$  inches.

"*Locality.* Claiborne, Alab. Cab. Acad. N. S." Conrad, 1833.

The group of *Calyptrophorus velatus* is widespread in the Claiborne and Jackson of the eastern and western Gulf regions. More than a single species has been included under this name, but the Mexican material is neither abundant nor well preserved, and the finer relationships cannot be traced. The present usage is to include under *C. velatus*, *s.l.*, the middle and upper Eocene forms characterized by a highly glazed and polished spire, flattened slightly in the plane of the aperture and tapering to an acute angle of a little less than  $45^\circ$ ; a flaring outer lip thickened at the margin, abruptly constricted anteriorly and joining the slender anterior canal at a high angle. The callus continuous with the inner lip is spread heavily over the apertural surface, caps the apex of the spire, and is continued forward to the body whorl. The spatulate margin of this callus is indicated by a deep groove separating it from the callus continuous with the outer lip; on a trigonal area at the back of the spire the callus is so thin that the underlying sculpture may be dimly traced. There are no protuberances such as those of *C. trinodiferus* and *C. carrizensis*. The protoconch includes several smooth shining whorls acutely tapering. The axials on the early conchal whorls are sharp and feebly arcuate, occasionally varicose; and number as a rule more than 20 to the turn. They begin to die out on about the seventh whorl of the conch, but the fine spiral liration persists.

A young individual of the *C. velatus* group is associated with *Volutocorbis lapparoides* in the middle Laredo formation at U.S.G.S. sta. 13685 (H-9), at Los Aldamas,  $1\frac{1}{2}$  kilometers east of El Barrio on Río San Juan, Nuevo León.

An incomplete shell from the upper part of the Laredo formation was collected from U.S.G.S. sta. 13541 (J-13).

*C. velatus*, *s.l.*, is recorded in beds of lower or middle Jackson age at U.S.G.S. sta. 13504 (M-8).

### Genus *Orthaulax* Gabb

- 1873. *Orthaulax* GABB, Acad. Nat. Sci. Philadelphia, Proc. for 1872, p. 272.
- 1873. *Orthaulax* GABB, Am. Philos. Soc., Trans., new ser., vol. 15, p. 234.
- 1885. *Hippochrenes* ZITTEL (part), Handbuch der Palaeontologie, vol. 2, p. 260.
- 1887. *Wagneria* HEILPRIN, Wagner Free Inst. Sci., Trans., vol. 1, p. 105.
- 1890. *Orthaulax* Gabb. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 169.
- 1915. *Orthaulax* Gabb. DALL, U. S. Nat. Mus., Bull. 90, p. 86.
- 1921. *Orthaulax* Gabb. COOKE, U. S. Geol. Survey, Prof. Paper 129-B, pp. 23-37, pls. 2-5.



TYPE, BY MONOTYPY: *Orthaulax inornatus* Gabb. Baitoa formation (Lower Miocene) of the Dominican Republic.

*Orthaulax* includes about half a dozen species of highly specialized strombs characterized by the envelopment of the spire in onion-like layers of callus which are not produced by the enlarged outer lip of the adult but by a continuous deposition beginning in the adolescent growth stages. In the adult *Calyptrophorus*, the outer callus may be broken away and the whorls of the spire revealed in all their youthful characters. This is not true of *Orthaulax*. The enveloping callus of the spire does not represent a single growth stage but successive growth from early youth.

Within its narrow areal range, the group is ideal for stratigraphic purposes. It is restricted, however, to the upper Oligocene and lower and middle Miocene of the mid-Americas.

### *Orthaulax pugnax* (Heilprin)

(Plate 19, figures 3, 4)

1887. *Wagneria pugnax* HEILPRIN, Wagner Free Inst. Sci., Trans., vol. 1, p. 106, pl. 15, figs. 36, 36a.  
 1890. *Orthaulax pugnax* Heilprin. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 170, pl. 8, figs. 5, 8.  
 1915. *Orthaulax pugnax* Heilprin. DALL, U. S. Nat. Mus., Bull. 90, p. 87, pl. 15, figs. 5, 10.  
 1916. *Orthaulax pugnax* Heilprin. DALL, U. S. Nat. Mus., Proc., vol. 51, p. 509.  
 1919. *Orthaulax pugnax* Heilprin. COOKE, Carnegie Inst. Washington, Pub. 291, p. 115, pl. 2, fig. 4.  
 1921. *Orthaulax pugnax* (Heilprin) Dall. COOKE, U. S. Geol. Survey, Prof. Paper 129-B, p. 28, pl. 2, figs. 7, 8; pl. 3, figs. 1a-4b.  
 1937. *Orthaulax pugnax* (Heilprin) Dall. MANSFIELD, Fla. Dept. Cons., Geol. Dept. Geol., Bull. 15, p. 143.

"Shell irregularly oval, obconical, flattened, the flattened appearance being due to three irregular swellings or knobs, one of which immediately adjoins the anteriorly-directed fissure of the aperture; aperture narrow, projected forward (in its upper course) as a closely compressed fissure, which in a crescential curve ascends to within a comparatively short distance of the apex of the spire; outer lip? (broken in specimen); inner lip largely developed, completely concealing the whorls of the spire, and duplicating for a very considerable extent the outer lip; spire freely enclosed in a pointed superstructure, or dome, built over it by an extension of the mantle; surface covered with longitudinal lines of growth, which extend continuously from the apex to the base.

"Length (of imperfect specimens, lacking probably upward of an inch), 2.7 inches; width, 1.75 inches." Heilprin, 1887.

Heilprin misunderstood the nature of preservation of the shell and incorporated solution phenomena in his specific and generic description.

"The genus *Wagneria* of Heilprin is founded on characters which are simply part of the process of mineralization. The type of *Wagneria* is a siliceous pseudomorph; the very thick coating of the spire having been only partially replaced by silica, thus leaving a hollow, geodic dome analagous to nothing in the original shell." Dall, 1890, p. 169.

The dreikanter outline of *O. pugnax* is highly characteristic and unique. Because of the typical development of this feature in the numerous specimens from U.S.G.S. sta. 13579 (P-25), their determination as *Orthaulax pugnax* has been made with assurance. The figured specimens are registered under U. S. Nat. Mus. 494947.

### *Orthaulax* sp.

Distorted molds of a large species, probably referable to *Orthaulax*, are abundant at U.S.G.S. sta. 14033 (P-25), 2 kilometers N.22°W of Mendez, Tamaulipas. This station has been referred to the upper Oligocene rather than to the lower Miocene because of the field relations.

### Superfamily NATICACEA

### Family NATICIDAE

### Genus *Gyrodes* Conrad

1860. *Gyrodes* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 289.  
 1927. *Gyrodes* Conrad. STEWART, Acad. Nat. Sci. Philadelphia, Proc., vol. 78, p. 328.



TYPE, BY SUBSEQUENT DESIGNATION (Stewart, Acad. Nat. Sci. Philadelphia, Proc., vol. 78, p. 329): *Natica* (*Gyrodes*) *crenata* Conrad = *Rapa supraplicata* Conrad. *Exogyra ponderosa* and *Exogyra costata* zones (Upper Cretaceous) from New Jersey to Texas. Stewart credited the designation of the type to Meek, 1876, but Meek's "example" is not generally accepted as a valid type designation.

"Globose, thin in substance; whorls channelled above; umbilicus profound, without a callus on the columella or base.

"A group of thin-shelled Cretaceous forms of the Naticidae family . . . ." Conrad, 1860.

*Gyrodes* is one of a relatively small group of Mollusca that barely survived the faunal break at the close of the Cretaceous. So intimately associated with the Cretaceous is it that, together with *Perissolax*, *Margaritella*, and *Anchura*, it was considered by Gabb to be "strictly characteristic of the cretaceous; so much so, that the presence of a single undoubted representative of either of these genera would be strong presumptive evidence of the cretaceous age of any rocks in which it might be found" (Gabb, Calif. Acad. Nat. Sci., Proc., vol. 3, p. 306, 1867).

The distribution of the group during the Cretaceous was world wide. The few scattered species which persist into the Tertiary are assembled by Cossmann under *Sigaretopsis*.

#### Subgenus *Sigaretopsis* Cossmann

1888. *Sigaretopsis* COSSMANN, Soc. royale malacolog. Belgique Annales, vol. 23, p. 172.

TYPE, BY ORIGINAL DESIGNATION: *Natica infundibulum* Watelet. Cuisien of the Oise, France.

The subgenus, considered by Cossmann to be genetically related to *Gyrodes*, is separated from it by the more pronounced reflection of the columellar margin, by the less acute peripheral margin of the umbilicus, and the development on the inner wall of the umbilicus of a more or less marked spiral striation.

A few Upper Cretaceous species and all the Eocene examples of *Gyrodes* have been included under *Sigaretopsis*. Though reduced in number, the distribution of these Tertiary descendants is widely scattered. *Sigaretopsis* has been reported from the Paleocene of Copenhagen, Denmark; the Mon-tien of Belgium; the Thanetian of the Anglo-French Basin; the lower Eocene of Cotentin; Muddy Creek, Victoria; and the Gulf Province of the American continent.

The American species *Natica* (*Gyrodes*) *aperta* Whitfield (Plate 14, figure 9) is restricted in its established distribution to the Tuscaloosa formation, though two specimens in our collections are reputedly from Woods Bluff, the most prolific fossiliferous horizon of the Bashi formation. It is apparently without representation in the Midway of the Western Gulf area.

*Natica* (*Gyrodes*) *alabamiensis* Whitfield, 1865, is the type of *Lacunaria* Conrad, 1866.

#### *Gyrodes* (*Sigaretopsis*) *canrenoides* Gardner, n. sp.

(Plate 15, figures 1-4, ?7, ?8)

Shell small, oblique in the apertural view; the spire very low. Whorls 5 or more in all, those of the conch and protoconch not separable, rapidly enlarging. Suture channeled toward the aperture. Shell in front of the suture of the adult whorls obliquely sulcate in the manner of *Natica canrena* Linnaeus of the Recent fauna; the sulci deep, retractive, and persistent almost to the periphery of the whorl. Characters of aperture and umbilicus obscured by the matrix but certainly for the most part open, perhaps partially filled by the thickening of the inner columellar wall.

DIMENSIONS OF LARGER COTYPE: Height, 7.5 millimeters; greatest diameter, 9.7 millimeters. Dimensions of smaller cotype: Height, 7.6 millimeters; greatest diameter, 9.3 millimeters. Dimensions of smallest figured specimen: Height, 7.6 millimeters; greatest diameter, 8.2 millimeters.

COTYPES: U. S. Nat. Mus. 495019. Smallest figured specimen: U. S. Nat. Mus. 495000.

Cotypes from U.S.G.S. sta. 13459 (B-6), 5.5 kilometers south-southeast of Agualeguas, Nuevo León. Smallest figured specimen from U.S.G.S. sta. 13463 (B-9), 7600 meters east of the old church at Cerralvo, Nuevo León. Lower part of Midway formation.

*Gyrodes canrenoides* resembles *Gyrodes rugifera* (Dall) which replaced the *Natica aperta* of Whitfield (Plate 14, figure 9) preoccupied by H. C. Lea in 1846. *Gyrodes rugifera* is abundant in the Tuscaloosa formation of western Alabama, especially at Gregg's Landing on the Alabama River. The shells



from the Midway group of Mexico are smaller than *G. rugifera*, the tabulation of the whorls of the spire obscure, and the sulci fringing the posterior suture fewer but stronger.

The smallest of the three specimens figured may not be specifically identical with the other two. It is less oblique which may be an age character, but the sulci upon the posterior ramp are relatively strong. Both forms are found in the lower Midway near Cerralvo and Agualeguas, Nuevo León.

DISTRIBUTION: Midway formation: lower Midway, U.S.G.S. sta. 13459 (B-6); U.S.G.S. sta. 13464 (B-9); U.S.G.S. sta. 13463 (B-9).

#### Genus *Natica* (Adanson) Scopoli

1777. *Natica* (Adanson) SCOPOLI, *Introductio ad historiam naturalem*, p. 392.

TYPE, BY SUBSEQUENT DESIGNATION (Anton, *Verzeichniss der Conchylien*, p. 31, 1839): *Nerita vitellus* Linnaeus. Recent in the west Pacific.

Shell porcellaneous, solid, ovate or globular, generally umbilicate, the umbilicus usually furnished with internal ridges and in one subgenus plugged with callus; external surface of the majority of forms smooth and polished; aperture holostomous, semicircular, or ovate in outline; outer lip sharp, smooth within; columellar lip subvertical, callused, nonplicate; parietal wash heavy; operculum calcareous.

This genus has been prominent since the mid-Mesozoic and is abundantly represented in the temperate and tropical seas of today.

The Naticas and the closely related *Polinices* show an unusual sex variation due to the size of the egg sac. In consequence the whorls of the shell of the female are much more inflated in front of the suture, and the general outline more turritid.

#### *Natica perspecta* Whitfield

(Plate 14, figure 11)

Synonymy and description of *Natica perspecta* Whitfield:

- 1865. *Natica perspecta* WHITFIELD, *Am. Jour. Conchology*, vol. 1, p. 264.
- 1886. *Natica perspecta* Whitfield. ALDRICH, *Geol. Survey Alabama, Bull.* 1, p. 59.
- 1890. *Natica perspecta* Whitfield, DE GREGORIO, *Annales géologie paléontologie*, vol. 7, p. 151.
- 1896. *Natica perspecta* Whitfield. HARRIS, *Bull. Am. Paleontology*, vol. 1, no. 4, p. 119, pl. 12, fig. 21.
- 1935. *Natica perspecta* Whitfield. GARDNER, *Univ. Texas Bull.* 3301, p. 303. (Not 1933 as on title page.)

"Shell oblique, of medium size; substance thick; volutions four in the largest individuals, very ventricose; spire low; suture very distinctly channelled; umbilicus proportionally large, entirely destitute of a callus, the volutions being distinctly visible to the apical one; aperture semilunate, the inner lip spreading somewhat on the preceding volution, opposite the umbilicus it is thin and emarginate; outer lip sharp; surface polished.

"This beautiful little shell differs from any described species, in the deep channelling of the suture and the characters of the umbilicus.

"*Locality*.—Nine miles below Prairie Bluff, Alabama." Whitfield, 1865.

DIMENSIONS OF SPECIMEN LOANED BY THE WALKER MUSEUM, University of Chicago, probably the holotype: Height, 10.5 millimeters; maximum diameter, 10.5 millimeters.

TYPE MATERIAL: Walker Museum 24517, University of Chicago, Chicago, Illinois.

The specimen loaned through the kindness of the Walker Museum agrees perfectly with our material from Matthews Landing, Alabama River, Alabama. There are 6 whorls, 3 in the small protoconch and 3 in the conch. The thick shell and strong curvature of the body are good specific characters. The margin of the umbilicus is also strongly rounded, and within the umbilicus is a faint and irregular spiral lineation.

In the eastern Gulf region, *Natica perspecta* has been recognized only in the upper Midway.

The Mexican material is imperfect, and the determinations somewhat dubious.

DISTRIBUTION: Midway formation: upper Midway, ?U.S.G.S. sta. 13488 (D-18). Upper Midway or lower part of Indio formation: ?U.S.G.S. sta. 13550 (D-18); ?U.S.G.S. sta. 13462 (E-18).

#### "*Natica*" sp.

A number of naticoids in the Mexican collections do not fall within the reasonable limits of any published species but are too poorly preserved to figure and to describe.



Palmer's "*Natella*" section may be represented in the middle Laredo at U.S.G.S. sta. 13643 (M-25). The genus is common in the upper part of the Jackson formation at U.S.G.S. sta. 14009 (M-13). Although most of the individuals are similar in size and shape, more than one species may be present. Forms close to and possibly identical with *N. permunda* Conrad have been recognized, but there are other individuals in which the umbilical keel does not seem to be developed.

*Neverita* (*Glossaulax*) is apparently represented by two individuals from U.S.G.S. sta. 13513 (M-11). The horizon is high in the Jackson formation.

#### Genus *Neverita* Risso

1826. *Neverita* RISSO, Histoire naturelle des principales productions de l'Europe méridionale, vol. 4, p. 149.

TYPE, BY MONOTYPY: *Neverita josephinia* Risso. Recent in the Mediterranean.

Shell of moderate dimensions, not very heavy, depressed elliptical and much broader than it is high. Spire low and small, scarcely rising above the broadly rounded body. Peripheral and basal curvature full and smooth. Aperture wide, lobate, obscurely guttered at the commissure. Outer lip obliquely arcuate, rounding smoothly in front into the heavier inner lip. Umbilicus crescentic, wide, and deep, the inner portion at least occupied by a heavy rib; terminal pad of umbilical rib fusing with the rather thin and irregular body wash.

Operculum thin, corneous, paucispiral, the nucleus close to the inner margin, and in line with the anterior extremity of the umbilical funicle.

The description is made from Mediterranean genotypes labeled by Weinkauff in the Jeffreys Collection.

#### *Neverita limula* (Conrad)

Nov. 1833. *Natica limula* CONRAD, Fossil shells of the Tertiary formations of North America, p. 46.

1937. *Neverita limula* (Conrad). PALMER, Bull. Am. Paleontology, vol. 7, p. 125, pl. 13, 14, 16, 19-22; pl. 80, figs. 13, 16.

"Obliquely suboval, smooth, with a short convex spire; umbilicus nearly closed by a profound callus; aperture elliptical." Conrad, Nov., 1833.

Palmer has discussed at length the variations of this apparently protean species and has correlated the variations with the names under which they have appeared in the literature. There is no reason to repeat a discussion already so adequately presented. The Mexican material is fairly abundant but very poorly preserved. The large, rather thin-shelled form which typifies the species at Claiborne is not present. The Mexican shells are smaller and commonly lower relatively, and the tendency toward a relatively low broad outline seems stronger in the older beds of the Laredo formation than it does in the younger. The umbilical pad which almost fills the umbilical funnel is a constant character. Recognition should be given to the differences between the lower and the upper Claiborne forms, but the distinctions should be worked out from more perfect material than that in the present collections from northeastern Mexico.

The subspecies *ceryx* is widely and abundantly distributed in the Laredo formation of northeastern Mexico, but *Neverita limula*, s.s., has not been reported from the area.

#### *Neverita limula ceryx* Gardner, n. subsp.

(Plate 14, figures 10, 12)

Shell rather small, obliquely ovate, including about 5 rapidly enlarging whorls, the nuclear turns probably 2 and the post-nuclear 3, though the dividing line is exceedingly obscure in the holotype. Body obliquely flattened posteriorly and the suture line dropping forward near the aperture. Surface smooth except for incrementals near the posterior suture. Aperture obliquely lobate, angulated at the commissure, produced and broadly rounded anteriorly. Outer lip thin, arcuate. Parietal callus heavy, continuous with the pad which terminates the umbilical rib and closes the posterior and medial portions of the umbilical opening. Umbilical chink commonly crescentic, extending from the inner margin of the aperture around the anterior extremity of the pad and part of distance back along the lateral margin.

DIMENSIONS OF HOLOTYPE: Height, 15.0 millimeters; diameter, 13.5 millimeters. Paratype: Height, 11.0 millimeters; diameter, 11.0 millimeters.



HOLOTYPE: U. S. Nat. Mus. 497107. Paratype: U. S. Nat. Mus. 497108.

TYPE LOCALITY: Holotype, U.S.G.S. sta. 13565 (H-12). Paratype, U.S.G.S. sta. 13685 (H-9). Middle part of the Laredo formation.

An author imposing a new name upon a naticoid of the *limula* group is, *ipso facto*, placed on the defensive. *Neverita limula* (Conrad) of the Gosport sand is usually half as large again as the Mexican species and relatively thin. The umbilical callus is rarely so heavy and does not so strongly suggest a little pad, and the umbilical chink is usually wider. The groove between the parietal callus and the terminal of the umbilical rib has not been noted in any of the lower Claiborne individuals. It is so commonly present in the topotypes of *limula* that it led Palmer to place the species in the section *Glossaulax* Pilsbry.

The distribution of the subspecies in the Gulf province is probably rather wide, but it is apparently restricted stratigraphically to the upper part of the lower Claiborne. *Neverita limula*, s.s., has not been observed at so low a horizon. Possibly, when the distribution is better recorded, *ceryx* will be given full specific rank. A related form (U. S. Nat. Mus. 497114) differs in the wider aperture and the more extended umbilical opening and is probably distinct. *Neverita onusta* Whitfield (Plate 14, figure 14) from the Tuscaloosa and Bashi formations is similar in general aspect, but the body whorl of the Wilcox species envelops a greater proportion of the spire and is less broadly and evenly rounded at the base than is the body of *N. limula ceryx*.

DISTRIBUTION: Laredo formation: lower Laredo, U.S.G.S. sta. 13560 (H-12); U.S.G.S. sta. 13600 (H-15); U.S.G.S. sta. 13596 (H-15); U.S.G.S. sta. 13602 (H-16); U.S.G.S. sta. 13618 (H-17); U.S.G.S. sta. 13968 (I-19); U.S.G.S. sta. 13970 (I-19); U.S.G.S. sta. 13971 (I-20); U.S.G.S. sta. 13967 (J-20); middle Laredo, U.S.G.S. sta. 13986 (G-2); U.S.G.S. sta. 13985 (G-2); U.S.G.S. sta. 13772 (G-3); U.S.G.S. sta. 13861 (H-4); U.S.G.S. sta. 13984 (H-6); U.S.G.S. sta. 13800 (H-9); U.S.G.S. sta. 13685 (H-9); U.S.G.S. sta. 13557 (H-10); U.S.G.S. sta. 13567 (H-11); U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. 13566 (H-12); U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13590 (I-13); U.S.G.S. sta. 13547 (I-14); U.S.G.S. sta. 13554 (I-14); U.S.G.S. sta. 13553 (H-15); U.S.G.S. sta. ?13644 (M-25); U.S.G.S. sta. ?13645 (M-25).

#### Genus *Polinices* Montfort

1810. *Polinices* DENYS DE MONTFORT, Conchyliologie systématique, vol. 2, p. 222.

TYPE, BY ORIGINAL DESIGNATION: *Polinices albus* Montfort = *Natica mammillaris* Lamarck = *Natica brunnea* Link. Recent in the West Indies.

Woodring (Carnegie Inst. Washington, Pub. 385, p. 385, 1928) has clarified the obscurity in the type designation:

"Montfort cites '*nerita mamilla* Linn.' in the synonymy of *Polinices albus*, but his figure, which represents the type of the genus, shows the West Indian shell generally known as *Natica mammillaris* Lamarck, for which the earliest name seems to be *Natica brunnea* Link. In the Oriental '*Nerita*' *mammilla* Linné the umbilicus is filled with callous."

The shell characters of *Polinices* are similar to those of *Natica*; the operculum, however, is corneous in *Polinices*; calcareous in *Natica*.

The shell is of medium size, ovate, including a few closely wound whorls appressed at the suture. The aperture is semioval, the parietal callus heavy and indented near the upper margin of the umbilicus.

The genus, though of later origin than *Natica*, is much more abundantly represented in the middle and late Tertiary and in the Recent East Coast waters.

#### *Polinices? alamedensis* Gardner, n. sp.

(Plate 15, figures 5, 6, 9, 10)

Shell rather small, heavy, low-spined, elongate ovate in outline. Line indicating the break between the conch and the protoconch obliterated. Whorls commonly 5, regularly and rapidly increasing in diameter, those of the spire rounded and, in front of the suture, flattened slightly. Body not strongly inflated, evenly drawn out in front. Surface smooth except for the incrementals which are most



obvious in front of the impressed suture. Aperture lobate. Parietal wall padded with callus, thickest toward the commissure. Umbilicus closed except for a narrow chink.

**DIMENSIONS OF HOLOTYPE:** Height, 16.5 millimeters; diameter, 11.4 millimeters. Dimensions of paratypes: Estimated height of first paratype, 15 millimeters; diameter of first, 10.5 millimeters; estimated height of second paratype, 14.5 millimeters; diameter of second, 11.0 millimeters.

**TYPE MATERIAL:** Holotype, U. S. Nat. Mus. 495009; two paratypes, U. S. Nat. Mus. 495026.

**TYPE LOCALITY OF HOLOTYPE AND PARATYPES:** U.S.G.S. Sta. 13492 (D-18), 4 kilometers north-northeast of Rancho La Alameda, Coyote Concession, China, Nuevo León. Midway formation.

*Polinices? alamedensis* is similar to some forms in the Wilcox which have been called *Natica eminula* Conrad. The type locality of Conrad's species is Claiborne, Alabama. The Claiborne species is a thinner shell with a lighter wash on the parietal wall and a more open umbilicus. Many specimens of *N. eminula* show, under magnification, a faint spiral striation. Nothing of the sort has been observed on any lower Eocene individual, though the absence might be due to less perfect preservation of the earlier forms. In *Polinices harrisii* Gardner (Plate 14, figure 13), from the Midway of Texas, the flattening of the whorls in front of the suture is more pronounced, and the umbilicus is more open. The generic determination is dubious. The diagnostic characters of the naticoid genera are unfortunately not preserved in the fossils, and separation must be made on such casual characters as the outline.

**DISTRIBUTION:** Midway formation: lower Midway, U.S.G.S. sta. 13473 (B-6); undifferentiated Midway, U.S.G.S. sta. 13653 (C-17); U.S.G.S. sta. 13490 (D-18); U.S.G.S. sta. 13492 (D-18).

#### Genus *Ampullina* Bowdich

1822. *Ampullina* BOWDICH, Elements of conchology, pt. 1, p. 31.

1909. *Ampullina* (Lamarck) Bowdich. DALL, U. S. Geol. Survey, Prof. Paper 59, p. 89.

1927. *Ampullina* Bowdich. STEWART, Acad. Nat. Sci. Philadelphia, Proc., vol. 78, p. 330.

Not *Ampullina* Ferrussac, 1822 = *Natica* Lamarck.

**TYPE, BY ORIGINAL DESIGNATION** (a very poor figure): *Ampullina depressa* Lamarck? Eocene of the Paris Basin.

Shell rather large and relatively thin, globose. Spire higher and whorls more numerous than in most naticoids and obtusely shouldered. Aperture semiellipsoidal, the inner margin oblique; posterior commissure obscurely channeled. Outer lip thin, patulous, flaring a little anteriorly. Parietal wash moderately heavy, thickening in the region of the umbilicus and partially closing it; flattening in front of the umbilicus and merging into the callus that partially surrounds the umbilical opening. Sculpture limited to incrementals and rarely an obscure spiral lineation.

*Ampullina* includes a number of species from the rich naticoid fauna of the Paris basin. All the American species here considered are referable to the section *Ampullinopsis* Conrad. *Ampullina fischeri* Dall (Plate 19, figure 1), from the lower Miocene of Florida, illustrates *Ampullina* (*Ampullina*).

#### Section *Ampullinopsis* Conrad

1865. *Ampullinopsis* CONRAD, Am. Jour. Conchology, vol. 1, p. 27.

1885. *Megatylotus* FISCHER, Manuel de conchyliologie, p. 766. Type, by monotypy, *Ampullina crassatina* Lamarck.

**TYPE, BY MONOTYPY:** *Natica mississippiensis* Conrad. Oligocene of the Gulf Province.

The group is characterized by the channeled suture. So slight a difference would not perhaps deserve taxonomic recognition except that it seems to have a time value and that *Ampullinopsis* is particularly characteristic of the Oligocene and lower Miocene ampullinid faunas both in the European and in the American Tertiary.

#### *Ampullina dumblei* (Heilprin)

1891. *Natica Dumblei* HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, pp. 399, 404, pl. 11, fig. 3.

1937. *Ampullina recurva dumblei* (Heilprin). PALMER, Bull. Am. Paleontology, vol. 7, p. 134, pl. 14, figs. 10, 11.



"Shell globular, smooth; whorls about five, moderately convex, and flattened slightly on the shoulder; suture impressed; aperture about two-thirds the length of shell; columellar surface flattened; umbilicus probably wanting.

"Length (height), 2.3 inches; greatest width, about the same.

"Station 2, Rio Grande; one specimen, filled with matrix.

"This species seems closely allied to *Natica crassatina*, Lamarck, from the Paris Basin, and may prove to be that form. It is the largest of our Eocene *Naticas*; named after the State Geologist of Texas." Heilprin, 1891.

The typical large forms familiar to every collector in the Rio Grande Embayment seem to be governed in their distribution by ecological conditions rather than by time. In the river section above Laredo typical *dumblei* has been collected about 80 feet above the top of the Mount Selman, and it is commonly associated with *Callocardia astartoides* and *Cerithium webbi*. In Arroyo Chacon below Laredo its common associates are the other large gastropods, *Lacinias* and *Cornulinas*. In northeastern Mexico, it occurs 400 feet above the Arroyo Chacon fauna. The species, though widely distributed, is rarely well preserved.

Smaller individuals, possibly distinct taxonomically from those of the later horizons, are present in abundance but in a very poor state of preservation in the lower Laredo at U.S.G.S. sta. 13560 (H-12).

DISTRIBUTION: Laredo formation: middle Laredo, ?U.S.G.S. sta. 13986 (G-2); U.S.G.S. sta. 13936 (G-3); U.S.G.S. sta. 13772 (G-3); U.S.G.S. sta. 13480 (F-4); upper Laredo, U.S.G.S. sta. 13769 (G-3); U.S.G.S. sta. 13768 (G-3); U.S.G.S. sta. 13987 (H-3); U.S.G.S. sta. 13944 (H-3); U.S.G.S. sta. 13943 (H-3); U.S.G.S. sta. 13958 (H-3); ?U.S.G.S. sta. 13979 (H-5). Yegua formation: U.S.G.S. sta. 14022 (J-7).

*Ampullina quitrinensis* Gardner, n. sp.

(Plate 13, figures 2, 3, 6, 7, 8)

Shell rather small for the genus, moderately thick and heavy, globose. Conch and protoconch not separable; about 6 whorls in all. Early volutions broadly convex and increasing in diameter fairly rapidly; later volutions arching smoothly into the channeled suture. Body whorl globose. Surface smooth except for incrementals. Aperture damaged in most individuals, obtusely angulated posteriorly, broadly rounded and patulous anteriorly. Outer lip strongly arcuate. Parietal wall callused, the wash continued forward and almost or completely closing the umbilicus. Inner lip somewhat thickened in front of the umbilicus.

DIMENSIONS OF HOLOTYPE: Height, 27.0 millimeters; diameter, 22.5 millimeters. Dimensions of imperfect paratype: Height, 22.8 millimeters; diameter, 22.0 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497100; paratype: U. S. Nat. Mus. 497102.

TYPE LOCALITY: U.S.G.S. sta. 13750 (J-6), west of Quitrin Ranch House, Mier, Tamaulipas.

The ampullinids occur in great abundance in the ash bed underlying the Roma sand of the lower Jackson. They pass with no perceptible break from individuals such as the figured types, which have much the aspect of *Cernina*, into forms scarcely separable from *Ampullina dumblei* (Heilprin). The species is probably genetically related to the earlier *A. dumblei* and possibly to *A. mississippiensis* of the Vicksburg fauna. No analogous species from the intermediate Jackson is known.

*Ampullina quitrinensis* has been certainly recognized at only the type locality, and no other fossils were associated with it.

DISTRIBUTION: Yegua formation: U.S.G.S. sta. 13750 (J-6); ?U.S.G.S. sta. 13741 (K-7).

*Ampullina mississippiensis* (Conrad)

(Plate 10, figures 18, 23)

Jan., 1848. *Natica mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 283.

Aug., 1848. *Natica mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 114, pl. 11, fig. 10.

1890. *Natica Mississippiensis* Conrad. DE GREGORIO, Annales géologie, paléontologie, vol. 7, p. 148.

1892. *Ampullina crassatina* Lamarck var. *mississippiensis* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 375.



"Subglobose, body whorl flattened above; suture channelled; spire little prominent; base profoundly callous; aperture moderate. Length 8-10.

"This rare species I found about seven or eight miles N.W. of Vicksburg." Conrad, 1848.

The species is characteristic of the Mint Spring marl and is possibly restricted in its known distribution in the Gulf province to that horizon. The Parisian species with which Dall united *A. mississippiensis* subspecifically is reported to be characteristic of the middle Oligocene of that province. The specimen labeled *A. crassatina* Deshayes in our collections is more inflated than the American form. The spire is relatively lower and broader, and the sutural channel deeper. No constant differences can be detected, however, between the Mississippian and the Mexican shells. The body whorl is ovate, with a tendency toward an obscure periphery, a character evident also in the Parisian species. The early whorls of the spire increase more rapidly than the later, and the final whorl of the spire is relatively high and trapezoidal. The protoconch is unknown. The sutural channel grows increasingly deep from the apex to the aperture. The incremental sculpture may be strong, especially on the later whorls. The aperture is pyriform, angulated at the commissure, evenly but somewhat obliquely rounded in front. The parietal wash is heavy, completely sealing the umbilicus and merging into the thickened, flattened pillar.

The figured specimens, U. S. Nat. Mus. 496031, are from the ashy sandstone at the base of the upper Middle Oligocene sandstone at U.S.G.S. sta. 13539 (N-17).

The ampullinids from the lower marine Oligocene sandstone of the Eastern Gulf province are larger than those from the higher horizons and may be subspecifically distinct. Apparently similar forms occur in abundance in the lower marine sandstone at U.S.G.S. sta. 13511 (M-11).

DISTRIBUTION: Ashy bed at base of upper Middle Oligocene sandstone: U.S.G.S. sta. 14023 (N-13); U.S.G.S. sta. 13539 (N-17).

### *Ampullina amphora* (Heilprin)

(Plate 19, figure 2)

1887. *Natica amphora* HEILPRIN, Wagner Free Inst. Sci., Trans., vol. 1, pp. 112, 120, pl. 16, fig. 50.  
 1892. *Ampullina amphora* Heilprin. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 375.  
 1915. *Ampullina amphora* Heilprin, DALL, U. S. Nat. Mus., Bull. 90, p. 108, pl. 11, fig. 5 (specimens from Chipola formation excluded).

"Shell semi-globular, depressed on the basal surface; spire elevated, of about four volutions, all the whorls deeply channeled along the sutural line; body-whorl about three-fourths the size of the entire shell; aperture semi-lunate, contracted above, effuse below; inner (columellar) border of aperture direct, diagonal; deposit of callus considerable, leaving a long, narrow umbilical fissure; base of shell sub-carinated; surface smooth.

"Length, about four inches; greatest width, across the centre of aperture, 3.7 inches." Heilprin, 1887.

The dimensions given by Heilprin are those of an unusually large individual. The Oligocene species *Ampullina mississippiensis* Conrad is less than half so large, the spire is lower, the early whorls increasing in altitude less rapidly than in *A. amphora*, and the umbilical opening is completely filled with callus.

Specimens from U.S.G.S. sta. 13579, 5 kilometers N. 21° W. of Mendez, agree with those from Ballast Point, Florida. A Mendez individual, U. S. Nat. Mus. 494951, has been figured.

DISTRIBUTION: Upper Oligocene limestone: U.S.G.S. sta. 13579 (P-25).

### *Incertae sedis*

Large helicoid or naticoid individuals, some of them exceeding 85 millimeters in diameter, have been recovered from a few localities in the upper part of the Laredo formation of northeastern Mexico. They are commonly crushed so that it is difficult to be sure of the original form and characters. The few fragments of adherent shell are rather thin and smooth except for growth lines. The periphery was probably sharply rounded, and the umbilicus seems to have been rather small for the diameter of the base. More than one species may be involved, but more probably crushing accounts for the variation in outline. The resemblance to the helicoid forms from the Oligocene is rather striking, but the Eocene individuals are much larger and are associated with more typically marine faunas. The Eocene faunas were, however, of shallow-water origin, for *Ostrea* and large cerites are common.



Whatever the name of the genus and species, it is a good horizon marker for the upper part of the Laredo formation in northeastern Mexico.

An adolescent shell from Ochoa, U.S.G.S. sta. 13741 (K-7), is referred to *Lysinoe*. The periphery of the adolescent is sharply rounded, the umbilicus rather narrow and margined by an obtuse keel. It is the only helicoid from the locality and is associated with a shallow-water marine fauna. The relationship to the larger forms from the upper Laredo may be close.

DISTRIBUTION: Laredo formation: upper Laredo; U.S.G.S. sta. 13943 (H-3); U.S.G.S. sta. 13944 (H-3); U.S.G.S. sta. 13528 (I-14). Yegua formation: U.S.G.S. sta. 13741 (K-7).

#### Genus *Amaurellina* Fischer

1885. *Amaurellina* FISCHER, Manuel conchyliologie, p. 766.

TYPE, BY MONOTYPY: *Ampullina spirata* Lamarck. Eocene of the Paris Basin.

Fischer erected *Amaurellina* for that section of *Ampullina* differing in the elevated acute and scalariform spire and the narrow umbilicus.

#### *Amaurellina singleyi* (Harris)

(Plate 13, figures 1, 4; Plate 14, figure 8)

1895. *Amauropsis singleyi* HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 84, pl. 9, fig. 12.

"General form and size as indicated by the figure; spire pointed and high; whorls 7; body and penultimate whorls shouldered above as in *N. recurva*; umbilicus small, partially hidden by the labium; margin of the aperture sharp, reflected.

"This species might be mistaken for the young of *recurva* were it not for the fact that the two have differently formed umbilici. In *recurva* there is a ridge formed by the continuation of the lower margin of the aperture that, after passing below and to the left of the umbilicus, winds up into the same as described by Aldrich. In *singleyi* the lower margin of the aperture stands out sharply. If traced upward and inward it will be found to follow the labium about one-third way across the umbilicus and then to wind up into the same.

"*Locality*.—Cedar Creek, Lee Co., Tex.

"*Geological horizon*.—Lower Claiborne Eocene.

"*Type*.—Collection of J. A. Singley." Harris, 1895.

Forms larger but otherwise similar to *Amaurellina singleyi* are recorded in several collections from the Rio Grande Embayment, both from the Texas side and from the Mexican.

The figured specimen from northern Tamaulipas is an incomplete and heavy shell of 5 whorls. Only the earliest is rounded evenly. The outline of the spire is scalar. The shoulder becomes increasingly prominent and at the body, is about 2 millimeters wide, horizontal, and defined at the periphery by a subacute angle; the growth lines on it are strong and retractive, stronger than the half dozen faintly discernible spiral threadlets fortuitously developed on the final and the penultimate whorls. The body is broadly rounded, contracting only slightly at the shoulder but more strongly and abruptly constricted at the umbilicus. The characters of the aperture are in part lost. The parietal callus is heavy and was probably continuous with the thickened margin of the aperture.

DIMENSIONS OF ADULT FIGURED SPECIMEN: Height, 32 millimeters; diameter, 23 millimeters. Dimensions of juvenile figured specimen: Height, 11 millimeters; diameter, 7 millimeters.

FIGURED SPECIMEN: Adult, U. S. Nat. Mus. 496029; juvenile, U. S. Nat. Mus. 559285.

LOCALITY OF FIGURED SPECIMEN: Adult, U.S.G.S. sta. 13644 (M-25); U.S.G.S. 13643 (M-25). Middle part of Laredo formation.

DISTRIBUTION: Laredo formation: middle Laredo, U.S.G.S. sta. 13800 (H-9); U.S.G.S. sta. 13634 (M-24); U.S.G.S. sta. 14148 (M-25); U.S.G.S. sta. 13643 (M-25); U.S.G.S. sta. 13644 (M-25); U.S.G.S. sta. 13645 (M-25); U.S.G.S. sta. 13640 (M-25).

#### Family SINIDAE

#### Genus *Sinum* (Bolten) Roeding

1798. *Sinum* (Bolten) ROEDING, Museum Boltenianum, pt. 2, p. 14. = *Sigarellus* LAMARCK, Prodrome d'une nouvelle classification des coquilles: Soc. histoire nat. Paris, Mém., p. 77, 1799.

1909. *Sinum* Bolten. DALL, U. S. Geol. Survey, Prof. Paper 59, p. 91.



TYPE, BY SUBSEQUENT DESIGNATION (DALL, U. S. Nat. Mus., Bull. 90, p. 109, 1915): *Helix haliotoidea* Linnaeus. Recent in the West Pacific?

Shell depressed, auriform. Protoconch smooth, paucispiral. Spire lateral, very low, with rapidly widening whorls. Sculpture delicate, spiral or reticulate. Aperture very large, oblique, dilated. Outer lip thin, sharp. Inner apertural margin concave, parietal wall callused. Umbilicus perforate or imperforate.

The genus is recorded from the late Mesozoic and, though never abundant, is fairly well represented in the Tertiary and Quaternary. The Recent species live on the mud and sand flats bordering the warm seas.

### *Sinum* sp.

*Sinum* sp., possibly, in part at least, *S. declive* (Conrad), 1833, is represented at several localities in northeastern Mexico by fragmentary and juvenile material. A large individual, about 22.0 millimeters high, from the lower part of the Laredo formation at U.S.G.S. sta. 13561 (H-12), 2125 meters east of Doctor Cos on the road to Loma Guajardo, Zacate, Nuevo León, seems more inflated and more erect than *S. declive* and may be referable to *S. bilix* (Conrad). The individuals from the other localities are all immature and more auriculate. They do not, however, represent the small, flattened *S. inconstans* (Meyer and Aldrich), a more regularly elliptical shell, with the apex set closer to the margin. The juveniles in question, all from the Laredo formation, at a higher horizon than that in which the inflated adult occurs, are from the following stations: U.S.G.S. sta. 13983 (G-4), U.S.G.S. sta. 13935 (H-3), U.S.G.S. sta. 13861 (H-4), and U.S.G.S. sta. 13643 (M-25).

### *Sinum mississippiense* (Conrad)

- Jan., 1848. *Sigaretus mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 283.  
 Aug., 1848. *Sigaretus mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 113, pl. 11, fig. 9.  
 1865. *Catinus mississippiensis* CONRAD, Am. Jour. Conchology, vol. 1, p. 27.  
 1892. *Sigaretus bilix* var. *mississippiensis* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, pp. 378, 379.  
 1937. *Sinum mississippiensis* Conrad. PALMER, Bull. Am. Paleontology, vol. 7, p. 140.

"Obliquely oval, with fine very closely arranged wrinkled revolving lines; whorls convex; no umbilicus. Length 8-10.

"This species is usually much smaller than the specimen described, and scarcely differs from a species [probably *S. bilix* Conrad] of Claiborne, Alabama. Not very common." Conrad, 1848.

The Oligocene species very closely resembles that described from Claiborne, but the Vicksburg forms seem consistently fuller. There is no record either of *S. bilix* or of *S. mississippiense* in the intermediate Jackson, and differences in outline must be given a higher rating in *Sinum* than in many other groups. Only the single species has been recognized in the Oligocene of Mexico, but this is widely distributed.

DISTRIBUTION: Lower marine Oligocene sandstone: U.S.G.S. sta. 13518 (N-10); U.S.G.S. sta. 13521 (M-10); U.S.G.S. sta. 13509 (M-11); U.S.G.S. sta. 13510 (M-11); U.S.G.S. sta. 14056 (M-12); "Vicksburg undifferentiated", U.S.G.S. sta. 14147 (O-22), upper marine Oligocene sandstone, U.S.G.S. sta. 13539 (N-17).

### Superfamily CYPRAEACEA

### Family CYPRAEIDAE

### Genus *Cypraedia* Swainson

1840. *Cypraedia* SWAINSON, Treatise on malacology, p. 325.  
 1937. *Cypraedia* Swainson. PALMER, Bull. Am. Paleontology, vol. 7, p. 232.

TYPE, BY MONOTYPY: *Cypraedia cancellata* Swainson, 1840 (not Gmelin, 1799) = *Cypraea elegans* Sowerby.

"Cypraeform; the base contracted; the body-whorl not flattened beneath; shell cancellated; aperture of equal breadth throughout; a few thickened, short teeth on the pillar; lip at the base, which is not internally concave." Swainson, 1840.



Palmer has discussed the irregularity of Swainson's monotype which is a *nomen nudum* unless the description of the genus may be accepted also as a specific description. A letter from Schilder is quoted in which he thinks such a course advisable and not without precedent.

A number of American species have been referred to *Cypraedia*, but some of them seem to be referable to *Sulcocypraea* rather than to *Cypraedia*, s.s. The cypraeid material from Mexico is imperfectly preserved.

The genus is restricted to the Eocene and Oligocene.

*Cypraedia* sp.

(Plate 17, figures 2-4)

The record of an ovate, spirally banded species is imperfectly preserved in the Jackson sandstones of northeastern Mexico. The posterior extremity may have been guttered, and the outer lip swollen, but the certain evidence for these characters has been lost. The sculpture is similar to that of "*Ovula (Transovula) multicarinata*" Dall, from the Ocala limestone of Florida. There are between 30 and 35 low spiral bands, regular in size and in spacing with a single delicate thread intercalated midway between each pair and faintly reticulated by the incrementals. The anterior extremity has been lost.

DIMENSIONS OF IMPERFECT FIGURED SPECIMEN: Height, 26.5 millimeters; diameter, 14.5 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 497122.

LOCALITY OF FIGURED SPECIMEN: U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7° 30' E. of Ciudad Camargo, Tamaulipas. Lower or middle part of Jackson formation.

The Ocala species "*O.*" *multicarinata* Dall is more inflated than that from Mexico. The body of the Mexican form is well rounded on the apertural face, but the flattening toward the outer lip is pronounced. Better material must be recovered before the species can be placed subgenerically.

*Cypraedia* sp.

(Plate 17, figures 1, 5, 6, 16, 17)

Cypraediids, probably referable to *Cypraedia*, s.s., are recorded at several localities in the Laredo formation. More than one species may be represented, but the sculptural pattern is similar in all, and the relatively slender outline indicated in Figure 17 of Plate 17 is due to crushing. The character of the posterior and anterior extremities cannot be determined in any specimens. The sculpture includes between 25 and 30 flattened cords, more elevated than those of the Jackson species, *C. multicarinata* (Dall), and between each pair of primaries a similar intercalary overridden by sharp and regularly spaced incrementals. The shell is shorter and broader than *Cypraedia* species from the Jackson of Mexico (Plate 17, figures 2-4). There is no closely related described form. *Cypraedia subcancellata* Johnson, from the lower part of the Claiborne at Smithville, is smaller and more slender. *Cypraedia gilberti* Palmer, from the Gosport sand, is a little larger, and the sculpture is reticulate. In *Sulcocypraea kennedyi* the spirals are not uniform and evenly spaced, as they are in *Cypraedia*, but tend to anastomose and interfinger, as they do in *Cypraea lintea* Conrad, the genotype of *Sulcocypraea*.

DIMENSIONS OF IMPERFECT FIGURED SPECIMENS: (U.S. Nat. Mus. 497121): Height, 22 millimeters; diameter, 17.5 millimeters. (U. S. Nat. Mus. 497128): Height, 23.5 millimeters; diameter, 19.0 millimeters. (U. S. Nat. Mus. 497129): Height, 21.5 millimeters; diameter, 12.0 millimeters (specimen crushed).

LOCALITIES: U. S. Nat. Mus. 497121, from U.S.G.S. sta. 13570 (H-12); U. S. Nat. Mus. 497128 and 497129, from U.S.G.S. sta. 13547 (I-14). All three specimens from the middle part of the Laredo formation.

Similar unfigured specimens occur in the upper Laredo at U.S.G.S. sta. 13935 (H-3); and in the middle Laredo at U.S.G.S. sta. 13553 (H-15).

Superfamily DOLIACEA

Family CASSIDIDAE

The cassids, and the Ficidae of northeastern Mexico, were discussed in part in my *Notes on fossils from the Eocene of the Gulf Province* (U. S. Geol. Survey, Prof. Paper 193-B, pp. 16-44, pls. 6-8, 6 text figs., 1939), and only references to the species will be made in this report.



Genus *Galeodea* Link

1807. *Galeodea* LINK, Beschreibung der Naturalien-Sammlung der Universität zu Rostock, pt. 3, p. 113.

TYPE, BY MONOTYPY: *Buccinum echinophorum* Linnaeus. Recent in the Mediterranean.

*Galeodea? shubutensis* (Aldrich)

1885. *Cassis* (*Semicassis*) *shubutensis* ALDRICH, Cincinnati Soc. Nat. Hist., Jour., vol. 8, p. 147, pl. 2, figs. 5a, 5b.  
 1886. *Cassis* (*Semicassis*) *shubutensis* ALDRICH, Alabama Geol. Survey, Bull. 1, p. 33, pl. 2, figs. 5a, 5b.  
 1939. *Galeodea? shubutensis* (Aldrich), GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 22.

The Mexican specimens seem smaller than *shubutensis* from Mississippi, the spires lower and the sculpture pattern more decided. The nodes on the shoulder spiral are more prominent, and the body primary spirals more elevated. The number of spirals is the same, however, in the Mexican species and in that from Mississippi, and the character of the secondary threading is similar in the two forms. The labral varix and the parietal callus are heavier in the smaller Mexican examples, but the canal has not been preserved.

*Galeodea? sp.*

Fragmentary material recalling the Jackson species *Galeodea* (*Galeodaria*) *peterstoni* Conrad in the tricarinate body, the absence of axial sculpture, and the character of the spiral sculpture was recovered from the upper Middle Oligocene sandstone at U.S.G.S. sta. 13539 (N-17) and from a slightly higher horizon at U.S.G.S. sta. 13581 (P-25).

Section *Mambrinia* Gardner

1939. *Mambrinia* GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 23.

TYPE: *Cassidaria planotecta* Meyer and Aldrich, Lisbon formation (Claiborne) of the Gulf province.

The section *Mambrinia* was created to include a group of species of the genus *Galeodea* intimately related biologically, restricted in their known stratigraphic range, and rather widely distributed geographically. The characteristic features of the shell are the bicarinate or obscurely tricarinate outline of the body whorl, the keels outlined by noded spirals, the remaining spiral sculpture usually fine and simple, only a single varix and that terminal, and a long, slender anterior canal produced in the plane of the aperture but not of the axis of the body and spire.

The group has been recognized in the Wilcox of the eastern and western Gulf, the Meganos of California, and the London clay of England; in the upper part of the lower Claiborne of the United States and of Mexico; in the Domengine of the western Tertiary, the Lutetian of the Paris Basin, and the Bracklesham beds of England; and in the Red Bluff of Mississippi and the Oligocene of Germany.

*Galeodea koureos* Gardner

1899. *Cassidaria brevidentata* var. HARRIS, Bull. Am. Paleontology, vol. 3, p. 67, pl. 8, fig. 18.  
 1939. *Galeodea* (*Mambrinia*) *koureos* GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 23.

TYPE MATERIAL: Holotype, U. S. Nat. Mus. 484078, from U.S.G.S. sta. 3098, Bells Landing, Alabama River, Monroe County, Ala. Paratype: U. S. Nat. Mus. 484079, from the Indio formation (middle part) at U.S.G.S. sta. 13661 (F-9).

Poorly preserved specimens, probably referable to this species, were collected also from the middle part of the Indio formation at U.S.G.S. sta. 13671 (E-10).

*Galeodea sp.*

1939. *Galeodea* (*Mambrinia*) sp. GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 24, pl. 7, figs. 3-5.

Molds to which fragments of the sculptured shell still adhere occur abundantly in the sandstones of the Indio formation in the vicinity of Rancho Blanco, Nuevo León. The molds indicate a relatively large species, probably at least 50 millimeters high. The whorls are few and are wound so that



the carinate periphery of the whorl is usually visible a little behind the suture line. The body is strongly bicarinate, with each keel bearing possibly 10 to 15 nodes that tend to alternate in position. There is no indication of a third keel on either the young or the very old specimens. Fragments of adherent shell indicate a fine liration, which probably covered the entire shell. The characters of the aperture are not preserved, but traces of a varicose outer lip are still retained on a few specimens. The canal is broken on all the individuals observed.

The absence of any indication of a third keel in front of the other two makes it improbable that these are conspecific with the species occurring in the Wilcox on the Rio San Juan.

The Galeodeas of the *Mambrinia* section mark an ill-defined faunal zone in the middle part of the Indio formation. The specimen (U. S. Nat. Mus. 494973) figured in Gardner, 1939, was collected at U.S.G.S. sta. 13466 (D-11); similar molds were recovered from U.S.G.S. stas. 13714 (E-4) and 13715 (E-4) and from U.S.G.S. sta. 13681 (E-9). A larger but otherwise similar form was taken from the lower part of the Indio formation at U.S.G.S. sta. 13679 (E-11).

***Galeodea planotecta* (Meyer and Aldrich)**

1886. *Cassidaria planotecta* MEYER AND ALDRICH, Cincinnati Soc. Nat. Hist., Jour., p. [43] (no printed pagination), pl. 2, fig. 14.  
 1939. *Galeodea (Mambrinia) planotecta* (Meyer and Aldrich) GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 24, pl. 7, figs. 1, 2, 10, 15.

The type was probably from the Lisbon formation exposed at Indian Mound, 3 miles east of Newton, Miss., in a cut of the Alabama and Vicksburg Railroad.

Closely related if not identical forms were recovered from the lower part of the Laredo formation at U.S.G.S. sta. 13559 (H-12), and from the middle Laredo at U.S.G.S. stas. 13984 (H-6), 13800 (H-9), and 13553 (H-15).

**Genus *Sconsia* Gray**

1847. *Sconsia* GRAY, Zool. Soc. London, Proc., pt. 15, p. 137.

TYPE, BY ORIGINAL DESIGNATION: *Cassidaria striata* Lamarck. Recent in the West Indies.

Shell of medium or rather large size, ovoid, the spire low and broad, the body broadly inflated. Protoconch horny, small, paucispiral, smooth, the initial turn immersed at the tip. Whorls of spire trapezoidal, increasing rapidly in diameter. Body broadly inflated, relatively large, the aperture more than two thirds the height of the shell. Sutures impressed. Entire surface spirally lirate, the lirae crowded and flattened except on the earlier whorls of the spire and the fasciole. Axial sculpture limited to strong incrementals, a terminal varix, and usually, though not in every case, a body varix, so placed that its sharply defined margin intercepts the reverted pillar callus at the base of the body. Terminal varix heavy, defined exteriorly by a shallow groove, lirate within. Parietal wash thin but widely spread, thickening and wrinkled toward the base of the body, lirate at right angles to the margin of the pillar. Anterior canal short, broad, the margins proximate; nasute, and emarginate at its extremity.

The genus has been discussed by Dall (U. S. Geol. Survey, Prof. Paper 59, p. 66, 1909), Pilsbry (Acad. Nat. Sci. Philadelphia, Proc., vol. 73, pp. 361-362, 1922), Woodring (Carnegie Inst. Washington, Pub. 385, pp. 308-309, 1928), Wrigley (Mal. Soc. London, Proc., vol. 21, pp. 114-116, 1934), and a number of others.

The inflated anterior fasciole and deep, obliquely directed terminal notch that characterize *Cassis* and *Semicassis* are absent in *Sconsia*, and both the labral and the parietal callus are relatively thin for the family. Because of its prominent anterior faciole, Woodring excludes from *Sconsia*, "*Cassis*" *nuperus* Conrad from the Gosport sand, a species cited both by Dall and by Pilsbry as ancestral to *S. lintea* Conrad of the Vicksburg fauna and *S. hodgii* Conrad of the Duplin fauna. Dall considered *Sconsia* as a subgenus of *Galeodea*, but Wrigley stressed the close affiliation of *Sconsia* to *Semicassis*.

True *Sconsia* is represented in the Oligocene both in northeastern Mexico and in the eastern Gulf province. The Recent species are restricted in their known distribution to the West Indies.

***Sconsia zacatensis* Gardner**

1939. *Sconsia zacatensis* GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 27, pl. 7, fig. 9.



The holotype, U. S. Nat. Mus. 497067, is from U.S.G.S. sta. 13509 (M-11), a fauna formerly considered upper Jackson but now referred to the lower Oligocene. *Sconsia zacatensis* is included also in a lower Oligocene fauna at U.S.G.S. sta. 13511 (M-11).

*Sconsia* sp.

Two partially silicified individuals, possibly referable to *Sconsia lintea* Conrad, were recovered from the ashly beds at the base of the upper middle Oligocene sandstone at U.S.G.S. sta. 13539 (N-17).

Family FICIDAE

Genus *Priscoficus* Conrad

1866. *Priscoficus* CONRAD, Am. Jour. Conchology, vol. 2, p. 100 (footnote).

TYPE, BY SUBSEQUENT DESIGNATION (Stewart, Acad. Nat. Sci. Philadelphia, Proc., vol. 78, p. 380, 1927): *Ficus intermedia* Mellville. Paleocene of the Anglo-Parisian basin.

The noded and carinated fig shells are characteristic of the early Tertiary, and there is no record of the group in post-Tertiary faunas.

Subgenus *Fulguroficus* Sacco, emended

1890. *Fulguroficus* SACCO, R. Univ. Torino, Mus. zool. anat. comp., Boll., vol. 5, no. 86, p. 27.  
 1891. *Fulguroficus* SACCO, Molluschi terreni terziarii Piemonte e Liguria, pt. 8, p. 41.  
 1904. *Urosyca* SACCO (part) Molluschi terreni terziarii Piemonte e Liguria, pt. 30, p. 102. Not  
*Urosyca* GABB, California Geol. Survey, Paleontology, vol. 2, p. 159, 1869. Genotype:  
*Urosyca caudata* Gabb (Martinez of California).  
 1929. *Fulguroficus* WRIGLEY, Malacol. Soc. London, Proc., vol. 18, pt. 5, p. 249.

TYPE BY SUBSEQUENT DESIGNATION (Sacco, 1891); *Pyrula burdigalensis* Sowerby. Burdigalian (Miocene) of southern France and Italy.

*Priscoficus* (*Fulguroficus*) *juvenis* (Whitfield)

1865. *Pyrula juvenis* WHITFIELD, Am. Jour. Conchology, vol. 1, p. 259.  
 1939. *Priscoficus* (*Fulguroficus*) *juvenis* (Whitfield). GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 31, pl. 7, fig. 17.

The species is widespread though not abundant in the Gulf province.

DISTRIBUTION IN MEXICO: Midway formation: upper Midway, ?U.S.G.S. sta. 13758 (B-19); upper Midway or lower part of Indio formation, ?U.S.G.S. sta. 13462 (E-18). Indio formation: middle Indio, ?U.S.G.S. sta. 13675 (E-9).

*Priscoficus* (*Fulguroficus*) *tritiaria* Gardner

1939. *Priscoficus* (*Fulguroficus*) *tritiaria* GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 32, pl. 7, fig. 6.

The type is U. S. Nat. Mus. 495180 from U.S.G.S. sta. 13488 (D-18) in the upper part of the Midway formation on Rio San Juan, near Rancho Viejo, China, Nuevo León, Mexico.

*Priscoficus* (*Fulguroficus*) sp.

1939. *Priscoficus* (*Fulguroficus*) sp., GARDNER, U. S. Geol. Survey 193-B, p. 32.

Small examples of one or more species of *Priscoficus* doubtless closely related to *Priscoficus juvenis* Whitfield and *P. tritiaria* Gardner, but possibly not specifically identical with either, have been recovered from several lower Eocene localities in northeastern Mexico. Most of the individuals are immature, and none is well preserved, but they at least indicate the fairly wide distribution of the subgenus within the area designated.

Such forms have been recovered from the upper Midway or lower part of the Indio formation at U.S.G.S. sta. 13550 (D-18); from the lower Indio at U.S.G.S. sta. 13669 (E-12); and from the middle Indio at U.S.G.S. sta. 13695 (E-6), and 13661 (F-9).



Genus *Perissolax* Gabb

1861. *Perissolax* GABB, Am. Philos. Soc., Proc., vol. 8, p. 122.  
 1919. *Pseudoperissolax* CLARK, Calif. Univ. Pub. Geology, vol. 11, p. 180.  
 1927. *Pseudoperissolax* Clark. STEWART, Acad. Nat. Sci. Philadelphia, Proc., vol. 78, pp. 429, 430.  
 1930. *Perissolax* Gabb. STEWART, Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, p. 41.

TYPE, BY SUBSEQUENT DESIGNATION (Stewart, Acad. Nat. Sci. Philadelphia, Spec. Pub. 3, p. 41):  
*Perissolax trivolvus* Gabb. Vincentown sand (lower Eocene) of New Jersey.

*Perissolax*, as defined, includes only the genotype, a few species from the west coast, *eocensis* (Aldrich) from the Gulf, *Perissolax diga* from Mexico, and "*Fusus* sp." from the Miike coal field, Japan. The West Coast species are all Eocene forms, and the Gulf and Mexican species are of Midway and early Wilcox age.

*Perissolax diga* Gardner

1939. *Perissolax diga* GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 34, pl. 7, figs. 7, 8.

The species is known only from the type, U. S. Nat. Mus. 495179, from probably the upper part of the Midway formation at U.S.G.S. sta. 13462 (E-18) on Rio San Juan, near Rancho Viejo, Nuevo León, Mexico.

*Perissolax diga* differs from *P. eocensis* (Aldrich), from the lower Eocene of the Gulf, in the possibly larger size, the earlier development of the peripheral keel, and the coarser threading on the spire.

Genus *Ficus* (Bolten) Roeding

1798. *Ficus* (Bolten) ROEDING, Mus. Boltenianum, pt. 2, p. 148.  
 1799. *Pyrula* LAMARCK, Prodrome d'une nouvelle classification des coquilles: Soc. hist. nat. Paris, Mém., p. 73. Type by monotypy: *Bulla ficus* Linnaeus.  
 1810. *Pirula* MONTFORT, Conchyliologie systématique, vol. 2, p. 486. Type by monotypy: *Murex ficus* Linnaeus. Recent in the East Indies.

TYPE, BY MONOTYPY: *Ficus communis* "Bolten" Roeding = *Ficus variegata* "Bolten" Roeding = *Bulla ficus* Gmelin = *Murex ficus* Linnaeus. The only other species cited by Roeding is *Ficus picta*, a *nomen nudum*.

*Ficus* was initiated after the Cretaceous and culminated in the Tertiary. The representation in Recent waters is rather meager and confined to tropical and subtropical regions, notably the Antilles, the Indian Ocean, and the Philippine Islands.

*Ficus amichel* Gardner

- Pyrula penita* of authors (part). Not *Pyrula penita* Conrad, Fossil shells of the Tertiary formations of North America, p. 32, 1833.  
 1939. *Ficus amichel* GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 34, pl. 7, figs. 21, 23.

Shells rather small for the group. Fig-shaped. Known only from 3 whorls of the conch, but the missing apex probably including not more than a fraction of a conchal whorl and the protoconch; remaining whorls of the spire broadly curved, rapidly enlarging; body obtusely shouldered, constricting smoothly into the broad and probably long anterior canal, of which the extremity is unfortunately lost. Sculpture a delicate netting of relatively strong primary spirals and intercalated secondaries, overridden by a very fine and regular axial lineation; 2 or 3 primary spirals on each whorl of the spire, probably about 20 on the body, those on the inflated portion of the body the most prominent and the most widely spaced. Suture line obscure, fringed by the fine axials, which creep back a little on the preceding whorl and adhere closely to it. Body, as viewed from the front, slender, the aperture relatively wide; outer lip broken. Inner wall of aperture free from glaze. Anterior canal rather slender for the genus.

DIMENSIONS OF HOLOTYPE: Height, 25 millimeters; diameter, 15 millimeters.

HOLOTYPE: U. S. Nat. Mus. 496032.

TYPE LOCALITY: U.S.G.S. sta. 13567 (H-11). Middle part of Laredo formation.

The species, like most of the rest of the group, is not abundantly represented, but it has been recognized at a number of localities in the middle Laredo.

Indeterminate juveniles, probably representing an allied species, were collected from the discocyclinid zone of the Mount Selman at U.S.G.S. sta. 13632 (L-24).



Excellent examples of *Ficus amichel* associated with a typical middle Laredo fauna have been recovered from the green sandstones near La Perla on the Rio Grande in Webb County, Texas (U.S.G.S. sta. 6436).

DISTRIBUTION: Laredo formation: middle Laredo, U.S.G.S. sta. 13567 (H-11); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13593 (I-13); U.S.G.S. sta. 13547 and U.S.G.S. sta. 13556 (I-14); U.S.G.S. sta. 13553 (H-15).

#### *Ficus* sp.

1939. *Ficus* sp. GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 35.

*Ficus filia* (Meyer), described from the Jackson of Mississippi, has not been recognized in the western Gulf, but the genus is represented by two species, from the Jackson formation, locally abundant, that seem intermediate between *filia* and the Vicksburg species, *F. mississippiensis* Conrad. The characters of the protoconch, which are of unusual importance in the taxonomy of the group have not been preserved in either form, and for that reason, as well as their generally poor state of preservation, they have not been named. The conch of the earlier form, which is abundant at U.S.G.S. sta. 13503 (N-8), seems relatively short and inflated, but it is known only from molds. The sculpture of both species differs from that of *F. mississippiensis* in the less prominent primary spirals and from both *filia* and *mississippiensis* in the more pronounced cancellation of the interprimary areas. The interprimary areas of the body of *F. filia* are grated with 10 or 12 exceedingly fine subequal spiral threadlets, those of *mississippiensis* by 1 to 3, the medial secondary, if there are 3, stronger than those on either side. In the earlier Mexican shell, the number may run up to 7, the medial spiral the strongest; in the later, the number may be decreased, and a tertiary system of spirals may be developed. The second species has been recognized only in the higher Jackson of the western Gulf at U.S.G.S. sta. 13598 (L-11); at U.S.G.S. sta. 13513 (M-11); and at U.S.G.S. sta. 14009 (M-13).

#### *Ficus mississippiensis* Conrad

1848. *Ficus mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 117.  
 1907. *Pyrula mississippiensis* Conrad. BURNETT SMITH, Acad. Nat. Sci. Philadelphia, Proc., pp. 210, 214, 215, 216, pl. 17, fig. 5 (initial whorls only).  
 1939. *Ficus mississippiensis* Conrad. GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 35, pl. 7, fig. 22.

The specific characters are, in the main, those of the genus. Burnett Smith, in his *Contribution to the morphology of Pyrula*, emphasized the monophyletic aspect of the group and the extraordinary similarity of the grosser morphologic features of the constituent species. These features, shared by *Ficus mississippiensis*, include the thin shell, the low, evenly and broadly rounded whorls of the spire, and the intricate cancellate sculpture. The protoconch is distinct, however, and exhibits 3 smooth, rapidly enlarging whorls. The spirals are initiated a fraction of a whorl before the axials, but the cancellate sculpture is well established by the end of the first quarter turn of the conch. In the genus *Ficus*, the earlier species, the Jackson *F. filia* and the Oligocene *F. mississippiensis*, include the greatest number of whorls in the protoconch. With the decrease in the number of whorls as the group advances through the later Tertiary and into the Recent there is an increase in the size of the initial whorl. In *F. papyratia* of the Recent Floridian fauna, which is similar to *F. mississippiensis* in the general character of the conch, there is a single nuclear volution, but it is relatively large and tumid.

DISTRIBUTION: Lower marine Oligocene sandstone: U.S.G.S. sta. 13505 (N-8); U.S.G.S. sta. 13518 (N-10); U.S.G.S. sta. 13509 (M-11); U.S.G.S. sta. 13511 (M-11); U.S.G.S. sta. 14056 (M-12); "Vicksburg" undifferentiated, U.S.G.S. sta. 14147 (O-22); Middle and upper Oligocene sandstone: U.S.G.S. sta. 13539 (N-17); U.S.G.S. sta. 14034 (P-25).

#### Family CYMATIIDAE

#### Genus *Personella* Conrad

1865. *Personella* CONRAD, Am. Jour. Conchology, vol. 1, p. 21.

TYPE, BY MONOTYPY: *Distortio (Personella) septemdentata* Gabb. Cook Mountain formation (middle Eocene) of Texas.

Shell rather small for the group, moderately heavy, lacking uniformity of outline and winding in the adult stages. Protoconch smooth, naticoid, performing 3 complete volutions. Beginning of



conch indicated by the initiation of 3 primary spirals which become increasingly prominent, the medial spiral outlining the obscure shoulder on the later whorls. Higher orders of spirals netted by the incrementals. Axial sculpture not uniform; the ribs of the laterally compressed early whorls numerous, equisized, equispaced, and nodulated by the primary spirals which override them; the regular reticulate sculpture in some individuals exhibited on less than 2 whorls, in others on at least 4. Breakdown in the regularity of the sculpture coincident with irregularities in the outline of the whorls and of their coiling. Later volutions axially sculptured with unequal and inequispaced costals with occasional resting stages and varices. Aperture obliquely lenticular, the outer lip feebly arched, varicose, and heavily dentate within; denticles usually 7 and conforming in number and position to the interspirals. Aperture expanded by the abrupt contraction of the body. Parietal wall too thin to obscure the sculpture. Pillar short, twisted, and bearing posteriorly a pinched fold which at the aperture is almost normal to the axis, and which, when the shell is broken, is visible to the apical region. Canal short, girded with a few strong spirals, recurved and truncate at its extremity.

*Personella septemdentata* (Gabb)

(Plate 17, figures 12, 13)

1860. *Distortio septemdentata* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 380, pl. 67, fig. 21.  
 1865. *Distortio (Personella) septemdentata* Gabb. CONRAD, Am. Jour. Conchology, vol. 1, p. 21.  
 1896. *Distortio septemdentata* Gabb. VAUGHAN, U. S. Geol. Survey, Bull. 142, p. 42.  
 1906. *Personella sep[tem]dentata* Gabb. VEATCH, U. S. Geol. Survey, Prof. Paper 46, pl. 19, fig. 4.  
 1920. *Distortrix septemdentata* Gabb. DUMBLE, Univ. Texas Bull. 1869, pp. 89, 92, 93, 95, 96, 97, 99, 100, 104, 105, 107. (Check lists)  
 1931. *Distortio septemdentata* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 102.  
 1932. *Personella septemdentata* (Gabb). WRIGLEY, Malacolog. Soc. London, Proc., vol. 20, pp. 135-136, pl. 11, fig. 18.  
 1937. *Distortio (Personella) septemdentata* Gabb. PALMER, Bull. Am. Paleontology, vol. 7, p. 260, pl. 34, figs. 10, 11.

"Short, robust; whorls eight, spire short, acuminate; mouth patulous, outer lip thin on the edge, thickened behind the edge and with seven robust teeth internally, inner lip thin, with a few small teeth, canal short, recurved, surface marked by varices and by irregular longitudinal ribs, crossed by numerous thick revolving lines, giving a coarsely reticulated appearance; between the revolving lines are numerous finer striae.

"Dimensions.—Length .9 in., length of mouth .4 in., width of body whorl .5 in." Gabb, 1860.

There are four paratypes and a holotype, 13284, in the collections of the Academy of Natural Sciences, Philadelphia. They came either from Wheelock or from Caldwell County, Texas.

The shell characters of *Personella septemdentata*, the genotype, have been discussed under the generic description and will not be repeated. The species is widely distributed in the western Gulf region, present but rare in the Alabama section, and apparently represented by a descendant, possibly of subspecific rank, in the Jackson of Mississippi. There is a high degree of individual variation in the species, and possibly with careful study these variations may be correlated. Topotypes may easily exceed 30 millimeters in height, and irregularities may include the pushing backward of the last quarter whorl across the preceding volution almost to the suture line. The Mexican specimens are all small and probably immature. The regular reticulate sculpture seems more restricted than on the shells from the Brazos River section, and the axial bumps and bulges and flattened, straplike spirals appear at an earlier stage in the growth of the shell. However, the material is inadequate to afford a basis for generalization.

The smaller shell figured (U. S. Nat. Mus. 497127) is 13.7 millimeters high and 9.5 millimeters in greatest diameter. The locality is U.S.G.S. sta. 13564 (H-12).

The other figured specimen, U. S. Nat. Mus. 497126, was also collected at U.S.G.S. sta. 13564, southeast of Doctor Cos, Carlos Cantú, Nuevo León.

On the Brazos, Renick and Stenzel report the species from a horizon below the Moseley limestone lentil to 20 feet above the Little Brazos limestone lentil. In Mexico, it is restricted to the lower part of the Laredo formation.

DISTRIBUTION: Laredo formation: lower Laredo, U.S.G.S. sta. 13560 (H-12); U.S.G.S. sta. 13564 (H-12); ?U.S.G.S. sta. 13599 (H-15); ?U.S.G.S. sta. 13595 (H-15); U.S.G.S. sta. 13602 (H-16); U.S. G.S. sta. 13597 (I-18).



Genus *Cymia* Mörch

1861. *Cymia* MÖRCH, Malakozoologische Blätter, vol. 7, pp. 97, 98. = *Cuma* of authors. Not *Cuma* Milne-Edwards, 1828, Crustacea.

TYPE, BY SUBSEQUENT DESIGNATION (Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 154, 1890): *Buccinum tectum* Wood. Recent on the West Coast of Middle America and south to Peru.

A closely related species is recorded in the middle Miocene faunas of Santo Domingo. Dall believed the genus to be of Antillean origin and one that had barely reached the Pacific when the waterway between the two oceans was closed. The area of distribution of the Recent species in American waters is restricted to the Pacific coast of Central America and Panama and northern South America. Moreley-Davies reports it also from the Indo-Pacific.

The genotype is moderately large, heavy, and biconic; the apical angle not far from 75°, and the profile of the spire fairly regular, for the suture follows the periphery, and only the steep shoulder ramp is exposed. Peripheral nodes are prominently developed on the body and feebly on the later whorls of the spire. The entire shell from the small nuclear whorls to the anterior fasciole is spirally banded, the bands more or less irregular and separated by deeply incised, commonly undercutting grooves. Both the spirals and the interspirals are overridden by incrementals which are much more conspicuous in the grooves. The aperture is more than half as long as the entire shell and not very wide. The outer lip is angulated at the periphery and obliquely truncate in front of and behind the periphery. The posterior extremity of the aperture is guttered, and in front of the gutter on the parietal wall there is a strong cord which persists far within the aperture. The parietal wash is rather heavy but spread over a narrow and clearly defined area. Nearly midway from the commissure to the canal, a strong fold normal to the axis of the shell just reaches the mouth of the aperture. The base of the body is obliquely constricted into a short, broad, feebly concave neck, with sculpture slightly coarser than that on the side of the body. The anterior fasciole is arched, incrementally wrinkled but not lirate. The terminal notch is a moderately deep, obliquely directed U. The reverted pillar lip does not entirely conceal the umbilical opening.

Section *Tritonopsis* Conrad

1865. *Tritonopsis* CONRAD, Am. Jour. Conchology, vol. 1, p. 20.

TYPE, BY MONOTYPY: *Triton subalveatum* Conrad. Vicksburg of Mississippi.

*Tritonopsis* may be retained for the earlier species of relatively small size, less angular outline, and more clearly defined neck.

*Cymia* sp.

A single individual buried in a resistant matrix was recovered from the lower marine Oligocene sandstone at U.S.G.S. sta. 14056 (M-12), Zacate, Nuevo León. It is of unusual interest because the resemblance to the genotype is so much closer than it is in the Vicksburg species. The Mexican shell is no larger than that from Vicksburg, but the spire is low, the shoulder ramp broad, and the suture is slightly in advance of the periphery. The spirals are coarse and not uniform in width, but, as in true *Cymia*, they are low and broad and separated by incised grooves roughened by the strong incrementals. The characters of the anterior portion of the shell are, unfortunately, greatly obscured.

*Incertae sedis*

Remains of an unidentified species common in the lower part of the Midway formation near Cerralvo at U.S.G.S. sta. 13464 (B-9) are sufficiently well characterized to be recognizable and are possibly of stratigraphic value. They are small, slender molds of about half a dozen evenly diminishing whorls, the aperture less than half the altitude of the entire shell. The axial riblets are narrow, cordate, and numerous, ranging between 15 and 20 on the later whorls and tending to be in line at the sutures. The spirals are sharp overriding lirae, and the posterior is noded slightly at the intersection with the axials. The characters of the aperture are not well known. The outer lip may be a little thickened, and certainly in one individual it creeps backward upon the preceding whorl in the manner of the strombs. There is no evidence of columellar plications, but the apertures are so obscured by matrix that such a character might be present but concealed. If it were not for the backward creeping of the margin of the outer lip, these molds would suggest a *Phos*. A certain irregularity in the



axial sculpture, which may, perhaps, be due to the imperfect preservation, recalls the sculpture of some of the smaller tritons.

Suborder STENOGLOSSA

Superfamily MURICACEA

Family MURICIDAE

Genus *Murex* Linnaeus

1758. *Murex* LINNAEUS, *Systema naturae*, ed. 10, p. 746.

TYPE, BY SUBSEQUENT DESIGNATION (Montfort, *Conchyliologie systématique*, vol. 2, p. 619, 1810): *Murex pecten* Montfort = *Murex tribulus* Linnaeus. Recent in the South Pacific and Indian Oceans.

Shell oblong, oval, pyriform or fusiform in outline. Spire usually elevated, acutely tapering. Protoconch rather small, smooth, often somewhat turbinate, paucispiral. Ornamentation of conch elaborate; 3 axial varices in the restricted *Murex*, usually continuous, often spinose at the intersection with the spirals, less frequently foliaceous; simple costals commonly reduced on the later whorls to peripheral tubercles; spiral sculpture developed, as a rule, over the entire conch, overriding the axials; primary spirals commonly modified into spinose processes. Aperture subcircular, elliptical, or ovate. Labrum varicated, lirate or denticulate within. Labium nonplicate, heavily glazed, often rugose or denticulate in front of the commissure and along the pillar. Anterior canal long and straight or short and recurved, generally roofed in the adult.

*Murex* has a limited representation in the Cretaceous. In the succeeding Tertiary the genus becomes increasingly abundant, while the known Recent species number well over 200, the majority tropical and subtropical, from between tides to 50 fathoms.

*Murex (Murex) mississippiensis* Conrad

(Plate 19, figure 6)

Jan., 1848. *Murex Mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 286.

Aug., 1848. *Murex mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 116, pl. 11, fig. 30.

1890. *Murex mississippiensis* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 139 (part).

"Subfusiform, with three elevated varices, and an intermediate prominent obtuse longitudinal ridge; between two of the varices on the body whorl is a smaller ridge; revolving lines prominent, alternated in size, profound on the varices; longitudinal wrinkles distinct; labium with six prominent lines within, the margin regularly foliated; canal long. Length, 1 7/10." Conrad 1848.

TYPE LOCALITY: Vicksburg, Mississippi.

The extreme tip is lost in the individual figured, but 3 smooth, polished, somewhat turbinate whorls remain. The line between the conch and protoconch is very sharp. The protoconch ends with an arcuate riblet bent backward toward the apex. The conch begins with the abrupt change from the smooth glazed surface of the protoconch to a more earthy-textured shell sculptured with axial riblets overridden by 3 spiral lirae. The 9 axials on the earlier of the 4 1/4 whorls are fairly uniform in size and spacing, but on the adolescent shell, they tend to become unequal. The spirals increase by intercalation and by introduction at the posterior suture. The trivariolate character of the sculpture is not developed until the final whorl. The aperture is ovate and guttered posteriorly. The reverted inner lip forms a dense callus on the body wall and, at the entrance to the canal, is produced into a shelly roof that almost completely covers the canal. The fasciole bulges a little and is threaded with about half a dozen lirae. The flexure at the anterior extremity is less evident than in either of the two lower Miocene species.

DIMENSIONS OF FIGURED SPECIMEN: Height, 19.8 millimeters; diameter including varices, 11.8 millimeters; diameter at right angles to greatest diameter, 9.5 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 497258.



LOCALITY OF FIGURED SPECIMEN: U.S.G.S. sta. 13539 (N-17), Carlos Cantú, Nuevo León. Ashy bed at base of upper Middle Oligocene sandstone. The species has been recognized at the single locality.

*Murex* sp.

The external mold of a species apparently allied to *Murex* (*Murex*) *chipolanus* Dall (Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 139) was recovered from the yellow limestones of the Guajalote formation at U.S.G.S. sta. 13587 (W-30), 3250 meters south of the church tower in San Fernando, Tamaulipas. The specimen is young and seems a little more slender and more strongly sculptured spirally than the *Chipola* species.

*Incertae sedis*

Molds of several species of gastropods, not specifically determinable but most of them related apparently to the muricoids or tritons, are present and common in the Guajalote formation, at U.S. G.S. sta. 13584 (V-29), 8500 meters N. 42° W. of San Fernando, Tamaulipas.

Subgenus *Argobuccinum* Herrmannsen

1846. *Argobuccinum* HERRMANNSEN, Indicis generum malacozoorum, vol. 1, p. 77 = *Argobuccinum* Klein, 1753 (pre-binomial).

TYPE, BY ORIGINAL DESIGNATION AND BY MONOTYPY: *Ranella argus* Linnaeus. Recent in the circumpolar seas off South Africa, Australia, Chile, and the Tristan de Cunha Islands.

Shell of medium size, the whorls short, commonly obtusely angulated at the periphery, increasing rather rapidly in diameter. Both axial and spiral sculpture well developed; primary spirals in many species beaded or tuberculated; terminal varix prominent; a second varix, almost equally prominent, placed *Ranella*-like on the opposite side of the whorl, but, unlike *Ranella*, not uniformly continuous on the whorls of the spire. Body relatively large and inflated, constricted abruptly into the short recurved anterior canal. Aperture ovate, slightly oblique, channeled posteriorly; outer lip thickened and lirate within; inner wall of aperture excavated and heavily washed with callus. Extremity of short, twisted anterior canal truncate and emarginate.

The group has not been recognized in strata older than the Tertiary. The Recent species are apparently restricted to waters south of the Equator.

*Murex* (*Argobuccinum*?) sp.

A mold to which a few fragments of shell still adhere, indicates a species possibly referable to *Argobuccinum*. The surface is crowded with spirals arranged in a system of primaries, secondaries, and tertiaries. The form was recovered from U.S.G.S. sta. 13487 (D-18) probably in the upper part of the Midway formation.

Genus *Typhis* Montfort

1810. *Typhis* MONTFORT, Conchliologie systématique, vol. 2, p. 615.

TYPE, BY MONOTYPY: *Murex tubifer* Roissy. Eocene of the Paris Basin.

The shells of *Typhis* are muricoid in outline but are much smaller and are usually more delicate than those of *Murex*. The characteristic ornaments of the genus are the hollow, tubular spines, perforated at their extremities, superimposed in some species upon the varices, in others ascending from the intervarical areas. The latest tubular spine is occupied by the excurrent siphon. The anterior canal is short, recurved, and entirely closed in the adult forms.

The genus is fairly well represented in the Tertiary of the Paris Basin from the Thanetien upward. Its presence in most of the other well-known fossil localities in the central and southern European Tertiary and in the Tertiary of this country has been established, but it is nowhere abundant. The Recent forms are included under less than 25 described species and are for the most part denizens of the tropical and subtropical waters of the Mediterranean and the West Atlantic and South Pacific oceans.



*Typhis curvirostratus* Conrad

(Plate 14, figures 1, 2)

Jan., 1848. *Typhis curvirostratus* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 285.

Aug., 1848. *Typhis curvirostratus* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 116, pl. 11, fig. 29.

"Subfusiform; volutions 8, scalariform, varices or ribs profound; tubes long; that near the margin of aperture, thick, elongated; beak elongated, spiniform, much curved. Length 1/10. Not uncommon." Conrad, Jan., 1848.

TYPE LOCALITY: Vicksburg, Mississippi.

The whorls of the conch in topotypes of *curvirostratus* number about 7. The protoconch is small, erect, smooth, a dead white, and includes between  $1\frac{1}{2}$  and 2 volutions. The tip of the initial turn is tilted and immersed. Traces of tubes are present on the first postnuclear whorl, but varices are not developed until the shell is adult. On the earliest whorls, the shoulder is nearly horizontal, but on the middle and later volutions it is concave and interrupted at the varices by the dragging upward and backward of the shoulder to form a series of pockets. The varices are flattened at their posterior extremities into trigonal dentate processes which are bent inward and backward. There are 4 such varices on the body, and in each intervarical area a single tube bent outward. A low obtuse ridge in line with the posterior side of the tube falls midway between the varices. Incrementals are well developed on the shoulder, and a faint crackled spiral sculpture on the body. The varices are continued down along the anterior canal, but the intervarical ridges evanesce on the base. The aperture is oval, simple within, and the rim elevated and free. The anterior canal is closed between the aperture and the anterior extremity and is compressed and irregular in outline.

DIMENSIONS OF IMPERFECT FIGURED SPECIMEN: Height, 11.5 millimeters; diameter including varices, 8.8 millimeters; diameter at right angles to greatest diameter, 6 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 497104.

LOCALITY OF FIGURED SPECIMEN: U.S.G.S. sta. 13539 (N-17); ashy bed at base of upper Middle Oligocene sandstone.

The record rests upon the single imperfect individual which has been figured. However, fragments of a closely allied species were recovered from the upper part of the Jackson formation (U.S. G.S. sta. 14009 M-13), exposed in a ditch on the south side of the Monterrey-Reynosa Highway, 9200 meters west of Rancho La Coma, 11 kilometers S. 30°E. of point of V in State line, Zacate, General Bravo, Nuevo León.

## Superfamily BUCCINACEA

## Family PYRENIDAE

Genus *Mitrella* Risso

1826. *Mitrella* RISSO, Histoire naturelle des principales productions de l'Europe méridionale, vol. 4, p. 247.

TYPE, BY SUBSEQUENT DESIGNATION (Cox, Rept. Paleontology Zanzibar, Moll., p. 28, 1927): *Mitrella flaminea* Risso = *Murex scriptus* Linnaeus. Recent in the Mediterranean.

Shell rather small, fusiform. Spire elevated, the whorls evenly tapering. Protoconch small, smooth, blunt, paucispiral. Sculpture restricted to the feeble striae which gird the pillar and the anterior fasciole. Aperture rather narrow. Outer lip thickened a little, feebly emarginate posteriorly; denticulate within. Parietal wash moderately heavy. Pillar feebly rugose. Anterior canal not defined, the fasciole little or not at all expanded. Terminal notch U-shaped, oblique.

The Recent representatives in the warm and shallow waters are of world-wide distribution.

*Mitrella garzai* Gardner, n. sp.

(Plate 14, figure 6)

Shell small, slender, fusiform. Apex including the entire protoconch lost. A little more than 4 whorls of the conch remaining, the whorls of the spire compressed, regularly increasing in diameter,



separated by impressed sutures which do not interrupt the regularity of the profile. Body smoothly tapering into the broad pillar. No sculpture except a few lirae girding the pillar and the anterior fasciole. Aperture narrow, angulated posteriorly. Outer lip emarginate at the anal fasciole, dropping vertically to the bend into the terminal notch. Characters of aperture obscured by the matrix that fills the mouth. Thickening of labrum indicated by a slight irregularity in the suture line a little behind the labral margin. Pillar straight. Extremity lost, but the notch apparently rather narrow and obliquely directed.

DIMENSIONS OF IMPERFECT HOLOTYPE: Height, 5.6 millimeters; diameter, 2.1 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497106.

TYPE LOCALITY: U. S. Nat. Mus. 13644 (M-25), Arroyo Barretosa, 1800 meters northwest of Rancho Barretosa, Santa Ana, Tamaulipas. Middle part of the Laredo formation.

The species name recalls one of the captains under Colonel Escandon who was stationed in Camargo in the middle of the eighteenth century.

Another *Mitrella*, probably a distinct species, occurs in the calcareous lower Jackson sandstone at U.S.G.S. sta. 13503 (N-8), 20.8 kilometers S. 12°30' E. of Ciudad Camargo, Tamaulipas. The Jackson species is less smoothly tapering anteriorly, and the whorls of the spire are more numerous and less compressed.

#### Family NASSARIIDAE

#### Genus *Tritiaria* Conrad

1865. *Tritiaria* CONRAD, Am. Jour. Conchology, vol. 1, p. 21.

1928. *Tritiaria* WOODRING, Carnegie Inst. Washington, Pub. 385, p. 259.

TYPE, BY MONOTYPY: *Buccinum mississippiense*. Conrad. Vicksburg Oligocene of Mississippi.

Shell operculate, of moderate dimensions and thickness, conic or turrito-conic. Whorls closely appressed, feebly convex or shouldered. Protoconch for the most part smooth, polished, acuminate, performing a moderate number of turns. External surface both axially and spirally ornamented, as a rule, the axial sculpture dominant. Aperture obliquely lenticular or elliptical. Labrum more or less thickened and lirate within. Labium excavated at the base of the body. Parietal wall and pillar heavily glazed; edge of pillar except near the extremity elevated into a more or less prominent fold outlined posteriorly by a sulcus which is usually rather deep; fold not marginal at its termination but cutting across the pillar at a low angle. Denticles occasionally developed upon the reverted labium. Anterior canal very short, recurved at its extremity, the margins parallel. Anterior fasciole arched, cut off from the base of the body by a more or less sharply defined sulcus. Terminal notch usually deep and obliquely directed. Umbilicus imperforate or narrowly perforate.

*Tritiaria* has not been recognized in strata older than the Tertiary.

The Recent representatives of the genus have a world-wide distribution along the shores of the tropical and subtropical seas.

#### *Tritiaria cerralvensis* Gardner, n. sp.

(Plate 16, figures 5, 11)

Shell small and slender for the genus, the whorls obscurely shouldered, increasing slowly in diameter, and the body drawn out in front. Protoconch not preserved. Sculpture reticulate on the 4 final whorls of the conch. Axials narrow and cordlike, 12 to 14 on the earlier whorls of the conch, increasing in number with the increasing diameter of the whorl. Spirals fine, threadlike, overriding the axials and minutely nodding them, those on the shoulder of the whorl a little less fine than those in front of them; 4 or 5 to the whorl; secondaries developed on the later whorls of the spire and the posterior and medial portions of the body; the primaries evenly spaced except for the posterior which is close to the suture and more nodose than those in front of it. Body sculpture similar in character to that of the spire; secondaries not developed on the base. Aperture incomplete, obliquely lenticular. Outer lip probably varicose and dentate within. No trace of columellar plications retained. Anterior canal probably short, broken in all specimens available.

DIMENSIONS: Height of incomplete holotype, 8 millimeters; diameter, 4 millimeters.

HOLOTYPE: U. S. Nat. Mus. 495101.



**TYPE LOCALITY:** U.S.G.S. sta. 13464 (B-9), 7 kilometers east of the old church at Cerralvo, Cerralvo, Nuevo León. Lower part of Midway formation.

This incomplete material is described because the species is well characterized even in its imperfect state, because it is fairly common within the limited area in which it occurs, and because there is little hope of finding better material immediately.

An apparently related and undescribed form from 3 kilometers west of San Javier on the road to Agualeguas develops more axials and more spirals to the whorl, and there is little or no trace of a shoulder.

*Tritiaria? zacatensis* Gardner, n. sp.

(Plate 22, figure 13)

Shell small, slender, multispiral. Spire elevated, the aperture less than half the total height. Nucleus including 3 smooth whorls followed by about a quarter turn on which a feeble axial ribbing is developed; initial turn minute and largely immersed, the 2 succeeding whorls increasing rapidly in diameter and the final nuclear whorl much more inflated than those before it. Sculpture pattern uniform over the conch. Axial ribs strong, rounded, evenly elevated from suture to suture, and, across the base of the body, feebly retractive, 10 on the earliest volutions, reduced to 8 on the body; terminal rib little if at all stronger than the rest of the body axials. Entire surface of conch from the close of the nucleus to the terminal notch spirally lirae, 4 lirae on the first whorl of the conch, 6 on the last whorl of the spire; uniform in size and spacing, overriding the axials with no intercalated secondaries except on the medial portion of the body. Suture impressed, undulated by the axials of the preceding whorl. Aperture rather narrow, angulated posteriorly, its characters obscured by the matrix which fills it. Outer lip flaring a little. Inner margin of aperture constricted at the base of the body. Parietal wash moderately heavy but not widely distributed. Pillar short, apparently biplicate, the anterior fold at the angle of the feeble flexure. Anterior faciole wide, lirae, emarginate.

**DIMENSIONS OF HOLOTYPE:** Height, 8.4 millimeters; diameter, 4.0 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 497149.

**TYPE LOCALITY:** U.S.G.S. sta. 13513 (M-11). Upper part of Jackson formation.

The generic affinities of *T. ?zacatensis* are a little dubious. The sculpture pattern is that of *Terebrifusus*, but the aperture is wider, and the fine pillar plications that characterize *Terebrifusus* are not developed.

A closely related and possibly identical species is represented by several individuals from the lower marine Oligocene sandstone at U.S.G.S. sta. 13511 (M-11), Zacate, Nuevo León. The figured specimen is more rapidly and more acutely tapering than the unfigured form. The whorls seem a little higher, relatively, in the unfigured example, possibly because the ribs are not quite so high and a little more closely spaced and the spiral lirae are more numerous by two or three. The characters of the aperture are similar in the two forms.

Genus *Buccitriton* Conrad

1865. *Buccitriton* CONRAD, Am. Jour. Conchology, vol. 1, p. 20. No description; three species listed, *B. altus* Conrad, *Buccinum sagenum* Conrad, including as a synonym *Nassa cancellata* Lea and *Phos texanus* Gabb.

**TYPE, BY SUBSEQUENT DESIGNATION** (Cossmann, Essais paléoconchologie comp., vol. 4, p. 159, 1901): *Nassa cancellata* Lea = *Buccinum sagenum* Conrad. Gosport sand of Alabama.

Shell rather small, elevated conic. Nucleus large, including, in the genotype, about  $5\frac{1}{2}$  whorls, the first 2 very small and smooth, the succeeding 3 smooth and increasing rapidly in diameter, the final half turn of the protoconch axially ribbed. Whorls of conch shouldered in the genotype, little or not at all inflated medially, the body more than half as high as the entire shell, abruptly constricted into a short canal. Sculpture of narrow axial riblets with occasional varices and a less prominent spiral threading; a noded cord commonly present in front of the impressed suture. Aperture moderately wide, obliquely lenticular, obtusely angulated posteriorly. Outer lip more or less varicose, the intermittent series of lirae within the throat marking the earlier varices. Inner margin of aperture smoothly excavated. Parietal callus heavy, the outer edge sharp. Pillar short, bearing



an acute but obscurely defined marginal fold. Sulcus at base of body obscure. "Nassoid" keel at margin of fasciole acute, recurved, forming the long arm of the asymmetric, obliquely directed U-shaped terminal notch. Anterior fasciole short, narrow, lirated, incrementally striate.

*Buccitriton* is not far removed from *Tritiaria*. The nuclear characters are similar; the "nassoid" keel is common to both, though that of *Buccitriton* is sharper and the terminal notch deeper than in *Tritiaria*. The pillar fold in *Tritiaria* is not marginal at the outer extremity and is backed by a well-defined groove. In *Buccitriton*, the pillar fold is nothing more than the acutely pinched margin of the pillar with a scarcely perceptible depression behind it.

The genus has been recognized only in the Eocene of the Gulf Province.

*Buccitriton texanus* (Gabb)

1860. *Phos texanus* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 381, pl. 67, fig. 17.  
 1865. *Buccitriton altus* CONRAD, Am. Jour. Conchology, vol. 1, pp. 20, 211, pl. 21, fig. 9. (Figure very poor, but Palmer has seen the type and says that it is a worn *B. texanus* (Gabb).)  
 1865. *Buccitriton Texanum* (Gabb). CONRAD, Am. Jour. Conchology, vol. 1, p. 20.  
 1890. *Phos texanus* Gabb. DALL, Wagner Free Inst. Sci., Trans., vol. 1, p. 135.  
 1896. *Phos texanus* Gabb. VAUGHAN, U. S. Geol. Survey, Bull. 142, p. 42.  
 1901. *Buccitriton texanum* (Gabb). COSSMANN, Essais Paléoconchologie Comp., vol. 4, p. 160.  
 1920. *Phos texana* Gabb. DUMBLE, Univ. Texas Bull. 1869, pp. 89, 92, 93, 95, 96, 97, 99, 100, 101, 107.  
 1931. *Phos texanus* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 96, 102.  
 1937. *Buccitriton texanum* (Gabb). PALMER, Bull. Am. Paleontology, vol. 7, p. 305, pl. 41, figs. 2, 3, 6; pl. 85, fig. 1.

"Subfusiform, whorls eight, spire high; mouth small, outer lip with seven or eight teeth inside, inner lip with about six; canal very short, recurved; surface marked by numerous revolving ribs crossed by longitudinal ribs and very indistinct longitudinal impressed lines; the ribs are slightly thickened where they cross on the upper part of the whorl so as to present the appearance of small tubercles or nodes. The young shells, having but three or four whorls, are more robust, polished and coarsely reticulated by distant lines.

"Dimensions.—Length .5 in., length of mouth. .17 in., width of body whorl .22 in." Gabb, 1860.

HOLOTYPE AND SIX PARATYPES: Acad. Nat. Sci. Philadelphia, 13278.

TYPE LOCALITY: Wheelock or Caldwell County, Texas.

*Buccitriton texanus* is possibly a group name covering more than a single species. Renick and Stenzel, 1931, separated three "formae", each restricted to a definite horizon within the Cook Mountain, the individuals "with fine and crowded ornamentation occurring below the Moseley limestone" those "with coarser and less crowded ornamentation" at "about Little Brazos limestone". The species, *s.l.*, is exceedingly abundant and widely distributed in the Cook Mountain formation, but in south Texas it is far less common, and the few specimens, most of them juveniles, recovered from outcrops in the Mier district are not certainly determined. *Buccitriton chapai* is devoid of spiral sculpture except for the presutural sulcus, an exceedingly faint linear grooving, and the basal lirae. The nuclear whorls of *B. chapai* are notably more slender than those of *B. texanus*. One is at a loss to understand why the modifying adjective in *Buccitriton* should have been given the neuter form by so many authors. It is a compound, obviously of Triton, who blew his wreathed horn and was the son of Neptune.

DISTRIBUTION: Laredo formation, middle Laredo: ?U.S.G.S. sta. 13861 (H-4); ?U.S.G.S. sta. 13978 (H-5).

*Buccitriton chapai* Gardner, n. sp.

(Plate 16, figures 6, 8)

Shell rather small for the group, elevated conic, the aperture less than half as high as the entire shell. Extreme tip lost, the 4 remaining nuclear whorls rapidly increasing in height and diameter, only the final quarter turn axially sculptured. Whorls of conch slightly exceeding 4, increasing regularly in size, not inflated medially. Axial sculpture of cordate ribs, 15 on the early whorls, 16 on the body, occasionally varicose, uniform from the presutural groove to the anterior suture; truncated posterior extremities of the ribs appearing as a series of presutural nodes which give to the whorl the appearance of being narrowly tabulated. Spiral sculpture restricted to the shallow, obtuse, *Terebra*-like groove in front of the suture; obscure linear sulci, most clearly perceptible upon the body; 3 or



4 lirae girdling the base of the body. Characters of the anterior portion of the shell in part lost by the matrix which fills the aperture. Aperture moderately wide, angulated posteriorly. Outer lip nearly vertical from the posterior commissure to the abrupt constriction at the base of the body. Inner wall of aperture smoothly concave. Parietal callus heavy, the margin sharp. Character of pillar not known. Sulcus at base of body obscure. Margin of sulcus acutely elevated, forming the long posterior arm of the asymmetric obliquely directed U-shaped terminal notch. Short, lirate anterior fasciole forming the shorter arm of the notch.

**DIMENSIONS OF HOLOTYPE:** Height, 11.7 millimeters; diameter, 5.3 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 497851.

**TYPE LOCALITY:** U.S.G.S. sta. 13772 (G-3), 5780 meters N. 44° W., from church tower in Mier, Tamaulipas. Middle part of the Laredo formation.

*Buccitriton chapai* is so named in memory of D. José Florencio de Chapa to whom Colonel Escandon entrusted the political and military administration of the settlement of Mier at the time of its establishment on March 6, 1753. Even before the arrival of Escandon, there was a pueblo on the banks of the Alamo called, according to Alejandro Prieto, Paso del Cántaro.

*Buccitriton chapai* is remarkable for its narrow cordate ribs and the absence of spiral sculpture other than the presutural groove, the faint sulci, confined in many individuals to the body, and the liration on the base of the body. It is fairly common at the single locality at which it occurs.

***Buccitriton hilli jacksonensis* (Johnson)**

1899. *Phos hilli* Harris var. *jacksonensis* JOHNSON, Acad. Nat. Sci. Philadelphia, Proc., p. 76, pl. 1, fig. 11.

"The type of this variety may be described as follows: Shell with 8 whorls, apex smooth, the following whorl with only oblique ribs that soon assume the general sculpture of the shell, which consists of about 14 longitudinal ribs (on the body and first spiral whorl a number of these are united, forming wide ribs or varices), these are crossed by prominent revolving ridges (5 on the spirals and about 18 on the body whorl) that form conspicuous nodules, there are also fine alternating revolving raised lines; above the basal fold of the columella a smaller one is present. Length 12 mm., greatest diam. 5 mm.

"Numerous specimens from Jackson, Miss." Johnson, 1899.

This seems distinct from the more inflated and more sparsely sculptured *B. hilli* Harris, 1894, described from the Jackson of Vince Bluff, Saline River, Arkansas.

The Mexican shells from the lower or middle Jackson at U.S.G.S. sta. 13504 (M-8) are similar in form and general sculptural plan to the Jackson species described by Johnson. They are preserved only as impressions of the exterior and molds of the interior. The whorls may be a little higher, relatively, and more compressed than those of *jacksonensis*; the axials are similar in number and spacing, but there may be one more primary spiral to each of the later whorls. Individual variation might explain so slight a difference in sculptural detail.

**Genus *Uzita* H. and A. Adams**

1853. *Uzita* H. AND A. ADAMS, Genera Recent Mollusca, vol. 1, p. 120.

1928. *Uzita* H. AND A. ADAMS. WOODRING, Carnegie Inst. Washington, Pub. 385, p. 265.

**TYPE, BY SUBSEQUENT DESIGNATION** (Cossmann, Essais paléoconchologie comp., pt. 4, p. 205, 1901): *Buccinum migum* Bruguière. Recent, West Africa.

Shell small, solid, imperforate, bucciniform or conic. Spire elevated. Protoconch smooth, obtuse, naticoid. Conch strongly sculptured, usually cancellated. Aperture obliquely ovate, terminating in a short, recurved canal, emarginate anteriorly. Labrum heavy, arcuate, furrowed or dentate within. Labium reverted, heavily glazing the parietal wall, irregularly studded with denticles; entrance to both the anterior and the posterior siphonal canals indicated by opposing rugosities on the outer and the inner walls of the aperture; that at the inner margin of the entrance to the anterior canal, a modification of the acute pillar margin. Fasciole spirally threaded, cut off by a broad channel from the base of the body.

It does not seem reasonable to suppose that this abundant and ubiquitous group was nameless until 1853, but no convincing case has yet been made for the validity of any earlier name.

No representatives of the group are recorded in strata earlier than the Miocene, either in European or in American waters.



*Uzita waltonensis* (Gardner)

1936. *Alectrion waltonensis* GARDNER, Geol. Survey Florida, Bull. 14, p. 54, pl. 9, figs. 3, 4.

DIMENSIONS OF HOLOTYPE: Height, 12.7 millimeters; maximum diameter, 7.5 millimeters.

TYPE MATERIAL: Holotype and juvenile paratype, U. S. Nat. Mus. 371811.

TYPE LOCALITY: U.S.G.S. sta. 3742, Shell Bluff, on Shoal River, Walton County, Florida. Shoal River formation of the Alum Bluff group.

Small cancellate Uzitas, imperfect but indistinguishable from the Florida species in the characters retained, are abundant in the yellow limestones of the Guajalote formation at U.S.G.S. sta. 13584 (V-29) and 13588 (W-30). They more closely resemble the common species from the Shoal River than those from the lower formations of the Alum Bluff group, or any of the described West Indian forms.

## Family BUCCINIDAE?

Genus *Bolis* Gardner

*Neptunea* and *Chrysodomus* of authors. Not *Neptunea* Bolten, 1798 = *Chrysodomus* SWAINSON, 1840.

1937. *Sycostoma* PALMER. Not *Sycostoma* COX, 1931 = *Sycum* BAYLE, 1880.

1939. *Bolis* GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 36.

Shell buccinoid. Spire elongated. Whorls rounded and shouldered by the deep incision of the sutures. Nucleus very small, paucispiral, and unsculptured. Sculpture of conch restricted to fine revolving lines and indistinct incrementals. Aperture rather narrow, obliquely lenticular, and, in the adult, almost as long as the spire; channeled posteriorly. Outer lip simple or lirate within. Columella straight, in the adults, feebly flexed in the young; reinforced by a heavy reverted callus, which completely conceals the umbilical opening. Anterior canal short, broad, only very slightly recurved, and truncate.

GENOTYPE: *Bolis lisboa* Gardner. Lower Claiborne of Alabama.

*Bolis mexicana* Gardner

1939. *Bolis mexicana* GARDNER, U. S. Geol. Survey, Prof. Paper 193-B, p. 37, pl. 8, figs. 5, 7.

Shell of moderate dimensions for the genus, thick, biconic, the greatest diameter falling a little behind the median horizontal. Apex, including the entire protoconch, lost in all available material. Whorls of remaining conch numbering about 6, broadly arcuate and rapidly enlarging after the manner of the buccinoids; the posterior margin rolled in at the deeply impressed suture. Outer surface smooth except for the incrementals and exceedingly faint and irregular spiral striae. Aperture rather narrow, obliquely lenticular, its characters imperfectly preserved. Curvature of inner wall of aperture broad and smooth. Callus on inner wall unusually heavy. Anterior canal short, broad, and straight, the extremity broken in all specimens.

DIMENSIONS OF IMPERFECT HOLOTYPE: Height, 72.5 millimeters; diameter, 37.0 millimeters.

HOLOTYPE: U. S. Nat. Mus. 495054.

TYPE LOCALITY: U.S.G.S. sta. 13790, 12 kilometers southwest of Mier on main road from Mier to Cerralvo, Mier, Tamaulipas. Middle part of Laredo formation.

North of the Rio Grande, *Bolis mexicana* has been found in Arroyo Veleño, 1 mile above the highway bridge at U.S.G.S. sta. 13170. In Mexico, *Bolis mexicana* has been recovered only from the middle Laredo in the Mier district, from U.S.G.S. sta. 13986 (G-2); and U.S.G.S. stas. 13980 and 13790 (G-4).

## Family BUCCINIDAE

## Subfamily PSEUDOLIVINAE

Genus *Pseudoliva* Swainson

1840. *Pseudoliva* SWAINSON, Treatise on malacology, p. 82, fig. 3 a, p. 306.

TYPE, BY MONOTYPY: *Buccinum plumbeum* Chemnitz. Recent off the west coast of Africa.

"Shell thick oval, oliviform, ventricose; spire very short, acute; base with two parallel grooves, one of which forms a notch at the base of the outer lip; suture slightly channeled; inner lip very



thick, and turning inwards; aperture with an internal canal. Connects the Turbinellidae with the Volutidae.

"*P. plumbea*. Chem. 188, f. 1806, 1807." Swainson, 1840.

The group of *Pseudoliva*, s. l., was raised to subfamily rank by Fischer (*Manuel de conchyliologie*, p. 624, 1884). *Pseudoliva* shares with the other buccinoids the smooth, naticoid nucleus, the heavy shell of at least moderate dimensions, the nonplicate inner apertural wall, and the oblique terminal notch. It differs from most of them in the development of a deeply incised groove at the base of the body and in the absence of a neck. There is a wide variation in sculpture, both of degree and of kind, and the umbilicus may be perforate or imperforate. *Pseudoliva* ranges from the Upper Cretaceous to the Recent, but the crest was passed with the Eocene, and in the Recent sea only the genotype has been recorded.

*Pseudoliva nana* Gardner, n. sp.

(Plate 12, figures 5-8)

Shell very small for the genus, pyriform. Body enfolding the earlier whorls so that only the apex of the spire is visible in the adult. Probably about 5 whorls, the initial turn for the most part submerged. Apical surface a low cone rounding broadly and smoothly at the periphery; body obliquely compressed in front of the periphery. Surface smooth except for feeble incrementals and occasional traces of a spiral lineation strongest behind the periphery and in front of the shallow sulcus at the base of the body. Aperture narrow, obliquely lenticular. Outer lip broadly rounded, not thickened at the margin. Pillar heavily washed with callus. Anterior canal broad, deeply emarginate.

DIMENSIONS OF HOLOTYPE: Height, 12.7 millimeters; maximum diameter, 9.2 millimeters.

TYPE MATERIAL: Holotype, U. S. Nat. Mus. 495007; paratype, U. S. Nat. Mus. 495008.

TYPE LOCALITY: U.S.G.S. sta. 13459 (B-6), 5.5 kilometers south-southeast of Agualeguas, Nuevo León, Mexico. Lower part of Midway formation.

This is an abundant species at the type locality, and many of the individuals reach double the size of the type. No larger forms, however, are well preserved.

Along the shoulder of one small imperfect specimen from U.S.G.S. sta. 13490 (D-18) are low nodes evenly spaced. The spiral sculpture, too, is unusually strong, and the species may be distinct although the outline is that of the young of *P. nana*.

The body whorl of *Pseudoliva nana* is stouter and more conical than that of *P. ostrarupis* Harris, 1895, from the lower Eocene of Texas, and the spire of the Texas species is higher than that of *P. nana*. The shell described at the same time and from the same locality under the name of *P. ostrarupis pauper* is very much more slender and can scarcely be included within the limits of the species. Indeed, it more closely resembles the shell described by Whitfield as *Pseudoliva elliptica* (Plate 27, figures 3, 4), but, later referred by Harris to the group of *Ancillopsis altilis* (Conrad). Whitfield cited Vicksburg as the type locality of both *P. elliptica* and of *Monoptygma leai* (Plate 27, figures 2, 5), a form of similar aspect but with a monoplicate columella. Aldrich, 1887, revised a number of localities cited by Whitfield for shells described from an old collection made from an area with which Whitfield was not acquainted. The type of *Pseudoliva elliptica* was taken, according to Aldrich who was thoroughly familiar with the country and with the section, from Bell's Landing, on the Alabama River, Wilcox County, Alabama, and the type of *Monoptygma leai* probably came from Lisbon Bluff on the Alabama River, Monroe County, Alabama. Similar forms in the National Museum collections from Lisbon Bluff are restricted to the horizon of *Ostrea lisbonensis*.

DISTRIBUTION: Upper part of Midway formation: lower Midway, U.S.G.S. sta. 13459 (B-6); U.S.G.S. sta. 13473 (B-6): undifferentiated Midway, U.S.G.S. sta. 13490 (D-18).

*Pseudoliva santander* Gardner, n. sp.

(Plate 22, figure 24)

Shell large, rudely conic, the outline obscured by excess callus. Early whorls lost, and characters of adolescent largely concealed by the enveloping body, but probably similar in a general way to those of *P. vetusta* (Conrad). Body relatively large, heavy, broadly inflated, shouldered in the adult; callus thick, deposited along the suture of the final whorl, overtopping the spire in many individuals. Sculpture, other than incremental, obsolete or undeveloped even on the area in front of the pseudo-



livar groove. Aperture relatively short and narrow, obliquely elliptical. Callus pad at posterior commissure thickly spread from the suture to the groove, distorting the posterior portion of the body and the outer lip; a narrow and fairly deep channel between the pad and the labral margin. Pseudolivar groove narrow and deep. Anterior fasciole corrugated by the growth lines, broadly U-shaped terminally. Umbilicus keeled at the margin apparently closed by the reverted callus.

DIMENSIONS OF HOLOTYPE: Height of imperfect specimen, 47.5 millimeters; diameter, 42.5 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497256.

TYPE LOCALITY: U.S.G.S. sta. 13685 (H-9). Los Aldamas,  $1\frac{1}{2}$  kilometers east of El Barrio, in Río San Juan, Nuevo León, Mexico. Middle part of the Laredo formation.

*Pseudoliva santander* bears much the same relation to *P. vetusta* (Conrad) that the heavily washed *Volutospina tuomeyi* bears to volutes similar in general character but free from excessive callus. It is apparently restricted in space to that area covered, in the days of the Conquistadores, by the name Nuevo Santander and is characteristic of that fauna commonly known as the Arroyo Chacon fauna because of its excellent development in the Arroyo Chacon on the eastern margin of Laredo, Texas. Smaller forms, possibly referable to *P. santander* but not typical of it, have been recovered from a lower horizon in the Laredo formation.

DISTRIBUTION: Laredo formation: lower Laredo, U.S.G.S. sta. 13560 (H-12); U.S.G.S. sta. 13971 (I-20); middle Laredo, U.S.G.S. sta. 13800 (H-9); U.S.G.S. sta. 13685 (H-9); U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13547 (I-14).

### *Pseudoliva vetusta* (Conrad)

(Plate 16, figures 17, 19)

- 1833. *Monoceros vetusta* CONRAD, Fossil shells of the Tertiary formations of North America, vol. 1, no. 4, p. 44.
- 1835. *Monoceros vetustus* CONRAD, Fossil shells of the Tertiary formations of North America, vol. 1, no. 3 (republication), p. 37, pl. 15, fig. 3.
- 1853. *Acanthina* (*Gastridium*) *vetusta* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 6, p. 320 (synonymy excluded).
- 1865. *Sulcobuccinum* (*Buccinorbis*) *vetusta* CONRAD, Am. Jour. Conchology, vol. 1, p. 22, Philadelphia, 1865.
- 1866. *Pseudoliva* (*Buccinorbis*) *vetusta* CONRAD, Smithsonian Misc. Coll. 200, p. 17.
- 1937. *Pseudoliva vetusta* (Conrad). PALMER, Bull. Am. Paleontology, vol. 7, p. 310 (part), pl. 43, figs. 1, 4, 7, 8, 11-14.

"Subglobose, with revolving striae, obscure, except the base, where they are distinct; spire short, rapidly narrowing to the apex, which is acute; tooth short and robust, placed at the termination of an exterior groove; basal emargination profound; labrum acute on the margin." Conrad, 1833.

TYPE: Acad. Nat. Sci. Philadelphia.

TYPE LOCALITY: "Claiborne sand," Claiborne, Alabama.

*Pseudoliva vetusta* has been used commonly for a group rather than for a single species. It has covered a large number of widely distributed forms, ranging in age from the Midway into the Jackson and associated by reason of the low spire, medium or rather large inflated body, and a spiral sculpture regularly developed in front of the pseudolivar groove and, in many forms, behind it. The umbilicus may be open or closed. The species is here restricted to a race observed only in faunas of upper Claiborne or Jackson age and itself possibly susceptible to further division. The spire is low, and the body highly inflated. The two earliest of the 6 or 7 whorls are nuclear. The initial whorl is inflated and immersed at the tip, the second volution laterally compressed. A few axial wrinkles may be developed on the final quarter turn of the protoconch, but true sculpture is apparently not initiated until the opening of the conch. The whorls of the spire are very low and broadly arcuate and increase rapidly in diameter. A low and commonly obscure spiral liration is developed on the adolescent shell; traces of it may be retained in the adult, but it is clearly defined only in front of the deeply and squarely incised pseudolivar groove. The sutural channel increases in prominence toward the aperture; in the adult a narrow shoulder is developed, and the growth lines are insinuated on it. The pad is heaviest at the commissure, but the parietal wall is heavily glazed, and in some individuals, probably not specifically identical, the callus is extended forward, closing the umbilicus. The outer



lip is sharp, and in those forms in which the spiral sculpture is strong the margin is crenate. The growth lines are bent sharply forward in the pseudolivar groove producing at the aperture a dentate process. At the anterior fasciole they are bent sharply backward, and the notch so formed is a deep, asymmetric U, obliquely directed. The umbilical keel is prominent and double, the outer keel outlining the margin of the fasciolar sinus, the inner keel acute and marking the abrupt termination of the rugose incrementals. The umbilicus is smooth within, and the umbilical funnel auriculate.

Probably the Jackson species is distinct, at least subspecifically, for the axial sculpture seems stronger and more persistent, and the early whorls of the conch may be wrinkled axially. Of equal importance is the uniformly open umbilicus in the Jackson species. Our Claiborne material is meager and not well preserved, but the Claiborne individuals seem less evenly rounded than the Jackson forms and more inclined to develop an obscure, obliquely sloping shoulder. In forms of this outline, the channeling of the suture is very slight, and the umbilicus is commonly closed by a flattened or slightly depressed callus. The Mexican forms are inflated, but it is not possible to determine the sculpture of the early whorls or whether or not the umbilicus was open or closed.

For the relatively slender and small Lower Claiborne individuals, the name *P. fusiformis* Gabb non Lea is available. The holotype, Acad. Nat. Sci. Philadelphia, 13269, is reproduced (Plate 24, figures 11, 12.)

The figured individual, U. S. Nat. Mus. 559291, measures 31 millimeters in height and 22 millimeters in greatest diameter. It was included in a fauna from the debated *Nonionella cockfieldensis* zone outcropping on the west bank of the Sabine River, a quarter of a mile above Robinson's Ferry, Sabine County, Texas (U.S.G.S. sta. 15116).

DISTRIBUTION: Upper part of the Yegua formation: ?U.S.G.S. sta. 13750 (J-6). Jackson formation: lower or middle Jackson, ?U.S.G.S. sta. 13504 (M-8).

#### *Pseudoliva carinata* Gabb

(Plate 22, figures 15?, 16?, 17?, 18?)

- 1860. *Pseudoliva carinata* (Conrad MS), GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 381, pl. 67, fig. 32.
- 1865. *Sulcobuccinum* (*Buccinorbis*) *carinata* (Conrad MS) Gabb. CONRAD, Am. Jour. Conchology, vol. 1, p. 21.
- 1866. *Pseudoliva* (*Buccinorbis*) *carinata* CONRAD, Smithsonian Misc. Coll., vol. 7, no. 200, p. 17.
- 1891. *Pseudoliva carinata* Gabb. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, p. 398.
- 1931. *Pseudoliva carinata* Gabb, forma 1. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 96, 101, pl. 7, fig. 19.
- 1936. *Pseudoliva carinata* Gabb. STENZEL, Univ. Texas Bull. 3501, p. 276.
- 1937. *Pseudoliva vetusta perspectiva* Conrad in Gabb. PALMER, Bull. Am. Paleontology, vol. 7, no. 32, p. 313 (part), pl. 42, figs. 5, 6; pl. 85, fig. 4.

"Subovate; entire above the canal or impressed line; whorls five, rounded; suture channeled; aperture elliptical; umbilicus large and profoundly carinated within." Gabb, 1860.

Renick and Stenzel restrict the species to the Crockett member of the Claiborne group below the Moseley limestone, and below the basal conglomerate of the "Crockett marl". Associated with it are *Falsifusus mortoniopsis* and *Borsonia plenta* Aldrich and Harris.

Gabb credits the name to "Conrad MSS", but as there seems to be no other record of Conrad's concern with the species it is here credited to Gabb, who described and figured it. It includes a group of fusiform shells of medium size or smaller. Gabb makes no mention of axial sculpture. Individuals from Moseleys Ferry, similar in outline to that figured by Gabb, are axially rippled on the early whorls, and an obscure spiral liration is commonly perceptible over most of the shell and is constantly present in front of the pseudolivar groove. There is no conspicuous development of callus around the aperture or at the suture. The umbilicus is open and keeled along the auriculate margin.

Stenzel restricts the occurrence of *P. carinata* to the beds below the Moseley limestone, and of *P. perspectiva*, which may well be, as he implies, a stouter race of *carinata*, to "about the Little Brazos limestone". The differences are too much of degree rather than kind to be able to use them stratigraphically in faunas so imperfectly preserved as those from northeastern Mexico. The relation of the smaller *Pseudolivas* in Nuevo León to *P. santander*, known only from adults of senile character, is not clearly understood.



None of the Mexican forms resembling in outline the figure of Gabb's *carinata* retain any trace of axial rippling.

Figure 15 of Plate 22 indicates a form intermediate in outline between *P. carinata* and *P. perspectiva* but closer to *carinata*. It may well fall within the limits of *carinata* s. s. Figure 16 represents a rather small and slender form, probably not fully adult for a spiral sculpture may be traced over the entire surface. The specimen figured in Figures 17 and 18 is probably taxonomically distinct, but more closely related to *carinata* than to any other described species. The whorls of the spire are trapezoidal rather than broadly inflated as they are in *carinata*, and the characteristic difference in the diameters of the last whorl of the spire and of the body is not marked. Both forms were collected at the same locality.

**DIMENSIONS OF IMPERFECT FIGURED SPECIMENS:** Figure 15: height, 25.5 millimeters; diameter, 18 millimeters. Figure 16: height, 14.2 millimeters; diameter, 8.1 millimeters. Figures 17 and 18: height, 17.3 millimeters; diameter, 10.0 millimeters.

**FIGURED SPECIMENS:** Figure 15, U. S. Nat. Mus. 497252; Figure 16, U. S. Nat. Mus. 497251; Figures 17 and 18, U. S. Nat. Mus. 497447.

**LOCALITY OF FIGURED SPECIMENS:** Figure 15, U.S.G.S. sta. 13570 (H-12), General Bravo, Carlos Cantú, Nuevo León. Figures 16, 17, and 18, U.S.G.S. sta. 13454 (H-15), General Bravo, Carlos Cantú, Nuevo León. Laredo formation.

**DISTRIBUTION:** Laredo formation: lower Laredo, ?U.S.G.S. sta. 13454 (H-15); middle Laredo, ?U.S.G.S. sta. 13567 (H-11); ?U.S.G.S. sta. 13570 (H-12).

*Pseudoliva* sp. cf. *P. linosa* Gabb

(Plate 22, figure 19)

Synonymy and description of *Pseudoliva linosa* Gabb:

- 1860. *Pseudoliva linosa* (Conrad MS) GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 381, pl. 67, fig. 31.
- 1865. *Sulcobuccinum* (*Buccinorbis*) *linosa* (Conrad MS) Gabb. CONRAD, Am. Jour. Conchology, p. 21.
- 1866. *Pseudoliva linosa* CONRAD, Smithsonian Misc. Coll., vol. 7, no. 200, p. 17.
- 1931. *Pseudoliva linosa* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 102.
- 1937. *Pseudoliva vetusta linosa* Conrad in Gabb. PALMER, Bull. Am. Paleontology, vol. 7, p. 315, pl. 43, figs. 2, 3, 10.

"Subfusiform, spire high, whorls six; umbilicus open; suture profound; impressed line on the body whorl deep, rest of the whorl marked by numerous revolving ribs, first two or three whorls strongly undulate, aperture elliptical.

"*Dimensions*.—Length .45 in., width of body whorl .3 in., length of mouth .3 in." Gabb, 1860.

The immature figured specimen represents a species distinct from other members of the genus in northeastern Mexico, but I was unable to find Gabb's type of *linosa* in Philadelphia and to determine with any assurance the identity of the Mexican species with that described by Gabb. However, the sculpture pattern of the early whorls is apparently similar in the two species.

**HOLOTYPE:** Acad. Nat. Sci. Philadelphia 13270.

**DIMENSIONS OF IMPERFECT FIGURED SPECIMEN:** Height, 11.2 millimeters; diameter, 7.8 millimeters.

**FIGURED SPECIMEN:** U. S. Nat. Mus. 497253.

**LOCALITY OF FIGURED SPECIMEN:** U.S.G.S. sta. 13861 (H-4). Middle part of the Laredo formation.

*Pseudoliva* sp.

A new species is probably represented by a body whorl 34 millimeters in diameter and slightly greater in height. The peculiar features retained are an obscure axial sculpture, which may be little more than exaggerated growth lines, and, in front of the pseudolivar groove, a spiral liration seemingly coarser than that of any species described from the Gulf.

The specimen is U. S. Nat. Mus. 497449 from a coarse-grained gray sandstone of probable Yegua age at U.S.G.S. sta. 13741 (K-7), Rio San Juan, Ochoa, Camargo, Tamaulipas.



Genus *Ancillopsis* Conrad

1865. *Ancillopsis* CONRAD, Am. Jour. Conchology, vol. 1, p. 22. No description, but 4 species listed.

TYPE, BY SUBSEQUENT DESIGNATION (COSSMANN, Essais paléoconchologie comp., vol. 3, p. 45, 1899): *Ancillopsis altilis* Conrad. Eocene of the Gosport sand of Alabama.

Shell of at least moderate dimensions, ovate to subglobose. Body more than half as high as the entire shell, and commonly enveloping most of the spire. Protoconch small, imperfectly known. Whorls of conch not numerous. Surface smooth except for an exaggerated growth sculpture. Sutures obscured or concealed by the surface enamel which in some species is washed over the entire spire. Aperture widely expanded anteriorly, angulated and channeled posteriorly. Outer lip broadly arcuate. Inner margin of aperture smoothly and strongly concave, nonplicate. Parietal wash very heavy, the posterior pad dispersed backward in some individuals to the apex, and spread widely but rather evenly over the face of the body; callus flattening toward the pillar. Base of body girded behind the fasciole by a broad band, the posterior margin of the band indicated by a sharp change in the direction of the growth lines similar to that of *Pseudoliva*. A similar but less clearly defined band is indicated also by the growth lines directly in front of the posterior suture. Anterior fasciole conspicuously defined by the sharply elevated posterior margin and the corrugated surface. Terminal notch broad, deep, symmetrically disposed upon the fasciole.

*Ancillopsis* includes a number of curious shells, many of them with a pathologic aspect due to the excessive development of callus. The much smaller protoconch and the banding of the body by the change in the direction of the growth lines are probably significant characters in separating *Ancillopsis* from *Bullia*.

The forward kink of the growth lines near the base of the body is directly comparable to that exhibited by *Pseudoliva*, but in *Pseudoliva* the change in direction is emphasized by a squarely channeled groove. The extravagant development of callus shown in the genotype and other species of *Ancillopsis* is also duplicated in many species of *Pseudoliva*. The two genera are doubtless closely related. Both Gray in his description of the soft parts of *Bullia* and D'Orbigny in describing *Buccinanops* stress the inordinate size of the foot. This character is probably associated, not only in *Bullia* and *Buccinanops* but in *Ancillopsis* also, with the excessive growth of the callus.

The distribution of *Ancillopsis* is difficult to check because of the confusion of names. There are several species in the Eocene of the Gulf region and at least one, *A. patula* (Deshayes), in the Anglo-Parisian Eocene fauna. No true *Ancillopsis* has been identified from the later Tertiary or the Recent faunas.

*Ancillopsis subglobosa* Conrad

(Plate 22, figures 20, 21)

1832. *Ancillaria subglobosa* CONRAD, Fossil shells of the Tertiary formations of North America, p. 25, pl. 10, fig. 3.  
 1854. *Ancilla subglobosa* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., 1st ser., vol. 7, p. 30.  
 1865. *Ancillopsis subglobosa* CONRAD, Am. Jour. Conchology, vol. 1, p. 22.  
 1937. *Bullia altilis subglobosa* (Conrad). PALMER Bull. Am. Paleontology, vol. 7, p. 289, pl. 39, figs., 1, 4-6, 11, 12; pl. 40, figs. 1-3, 5.

"Subglobose or suboval; spire convex, with the tip suddenly exserted and subulate; apex acute; suture obsolete; columella profoundly callous, and projecting in the middle.

"*Locality.* Claiborne, Alab. Middle Tertiary.

"This singular species is perhaps the most ventricose of the genus, but has all the characters of *Ancillaria*. As several individuals were sent among other shells collected at random, they are probably abundant." Conrad, 1832.

DIMENSIONS OF FIGURED SPECIMENS: Height of larger form, 43.5 millimeters; diameter of larger form, 34.0 millimeters. Height of smaller form, 25.5 millimeters; diameter of smaller form, 16.8 millimeters.

FIGURED SPECIMENS: U. S. Nat. Mus. 497254.

LOCALITY OF FIGURED SPECIMENS: U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S.7°30' E. of Ciudad Camargo, Tamaulipas.



The specific identity of the Claiborne and the Jackson forms seems a little doubtful, but our material is imperfect, and in forms characterized by so excessive a development of callus the normal features are greatly obscured. Our Jackson specimens from Mexico seem relatively small and well formed, and the anterior fasciole is separated from the pillar callus by a groove that is more distinct than in most of the Claiborne individuals.

DISTRIBUTION: Jackson formation: lower or middle Jackson, U.S.G.S. sta. 13504 (M-8). An incomplete specimen of an apparently identical species was recovered from the lower part of the Laredo formation at U.S.G.S. sta. 13971 (I-20).

*Ancillopsis harrisi* (Palmer)

(Plate 22, figures 22, 23)

1928. *Bullia altile harrisi* PALMER, Jour. Paleontology, vol. 2, p. 29, pl. 7, figs. 7, 11, 12, 15.

1937. *Bullia altilis harrisi* PALMER, Bull. Am. Paleontology, vol. 7, p. 290, pl. 39, figs. 2, 3, 10, 13.

"Shell small, irregular in shape, flattened ventrally, protruded to the left; the anterior notch is as in *B. altile*; spire is usually depressed and enveloped in the callus; the callus spreads posteriorly and laterally and covers the greater portion of the shell; usually three distinct, large nodes or bumps occur, one on the inner lip just above the middle, one on the dorsal side of the body whorl and one laterally on the middle, left portion of the body whorl. Many specimens have the trinodular character developed strongly and the spire so enveloped in the callus that the true generic identity of the form is obscured. There are specimens which show the anterior notch and groove of *Bullia*.

"Named in honor of Prof. G. D. Harris of Cornell University.

"*Dimensions*.—17 mm., height; 14 mm., greatest diameter." Palmer, 1928.

TYPE LOCALITY: East bank of mouth of Gazley Creek, south side of Colorado River, Smithville, Bastrop County, Texas.

DIMENSIONS OF FIGURED SPECIMEN: Height, 21.5 millimeters; diameter, 15.0 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 497255.

LOCALITY OF FIGURED SPECIMEN: U.S.G.S. sta. 13554 (I-14). Middle Laredo formation.

Our Mexican specimens do not seem separable from the species described by Palmer, although the horizon from which they came is appreciably higher than that at Smithville. Specimens from a possibly synchronous horizon on San Miguel Creek, in southern Atascosa County, Texas, cannot be included. The characters of *A. harrisi* are sufficiently distinct to justify specific status.

*Ancillopsis?* sp.

Imperfect silicified shells referable possibly to *Ancillopsis*, possibly to *Pseudoliva*, are fairly common in the so-called lower Jackson, 4.1 miles northeast of Salineño, Starr County, Texas. The largest shell is about 35.0 millimeters high. The outline is full, the spire low and broad, the diameter of the broadly inflated body about three fourths of its height. The characters of the early part of the shell have been lost in all the specimens. The callus has washed back across the sutures and, particularly on the final whorl, is heavy and rugose. The pad at the posterior commissure is thick and widely dispersed, merging anteriorly with the heavy parietal wash. There is a ruff of callus in front of the posterior suture, and, behind the anterior fasciole, a band is differentiated by a forward kink in the growth lines which in the eroded shells appears as a shallow sulcus, similar to that of *Pseudoliva*. The anterior fasciole and the broad and deep terminal notch are similar to those of *Ancillopsis*.

These shells are mentioned partly because they indicate the close relationship between *Ancillopsis* and *Pseudoliva* and partly because the species is probably represented on the Mexican side, at locality U.S.G.S. sta. 13745 (J-8), 500 meters south of Paso del Pedernal on Rio San Juan, Mier, Tamaulipas. The horizon is probably the same although it is referred by the geologists working in Texas to the lower Jackson and by those working in Mexico to the upper part of the Yegua formation.

Subfamily MELONGENINAE

Genus *Melongena* Schumacher

1817. *Melongena* SCHUMACHER, Essai d'un nouveau système des habitations des vers testacés, p. 212.

TYPE, BY MONOTYPY: *Murex melongena* Linnaeus = *Pyrula melongena* of authors. Recent in the West Indies.



Shell rather large, heavy, pyriform. Spire relatively low, acutely tapering, the whorls usually angulated at the periphery and sharply nodulated or spinose; a row of spines may also gird the base of the body or the pillar. Spiral sculpture irregular, as a rule, and ill-defined. Aperture rather wide, oblong, ovate, or pyriform. Outer lip not thickened, smooth within. Columella simple. Parietal wall and pillar heavily callused. Anterior canal short and broad, not sharply differentiated. Anterior fasciole strongly and heavily corrugated by the growth lines, emarginate at the extremity. Umbilicus imperforate.

*Melongena* has been recognized in the Oligocene both of the Gulf and of southern Europe. The earliest representative of the genus reported from this country is *M. crassi-cornuta* Conrad from the Vicksburg of Mississippi. *Melongena? potomacensis* Clark and Martin from the Eocene of Maryland is not a *Melongena*. The genus has not been a very conspicuous element in any fauna, but it is rather widely distributed in the shallow inshore waters of the Recent tropical seas.

*Melongena* sp.

(Plate 19, figure 5)

An undescribed species of *Melongena* is apparently represented in a fragmentary spire (U. S. Nat. Mus. 497257) recovered from U.S.G.S. sta. 13581 (P-25). It is associated with a fauna of post-Vicksburg age. The apex is lost, but 5 broadly shouldered, strongly carinated volutions remain, the suture coincident with the periphery on the later whorls but falling an appreciable interval in front of it on the earlier volutions. The early whorls are obliquely rippled by 8 protractive axial riblets which die out on or before the penultimate whorl. The incrementals are strong and obliquely convex forward, except on the anal fasciole. The spirals are crude, irregular in size and spacing, and number less than half a dozen on the shoulder. The posterior fasciolar channel on the later whorls is clearly defined by the sharply raised anterior margin and by the abrupt change in the direction of the growth lines. The anal notch is deep and broadly U-shaped, the anterior arm of the U somewhat shorter than the posterior arm. No other characters have been preserved, and no specimens other than the figured form are known. The diameter of the body probably exceeded 50.0 millimeters.

Genus *Cornulina* Conrad

1853. *Cornulina* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., 1st ser., vol. 6, p. 321.

TYPE, BY SUBSEQUENT DESIGNATION (Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 118, 1890): *Murex minax* Solander in Brander (Plate 20, figure 5) = *Fusus minax* Lamarck. Eocene of the Anglo-French Basin. Palmer, 1937, cites Fischer, 1884, as the first to name the genotype, but Fischer's examples have not been accepted as type designations. Palmer is quite right, however, in saying that "the established characters of the genus would not be disturbed if either form was used as the type [*Murex minax* or *Monoceros armigerus*]."

Shell large, inflated. Spire low, the apical angle not far from 90°. Body large, constricted basally into a well-defined neck. Whorls closely appressed, the suture line following directly upon or a little in front of the spinose periphery of the shoulder ramp. A second less prominent row of spinose tubercles girdling the base of the body and staggering the peripheral series. A groove similar to that of *Pseudoliva* and, like it, involving a change in the direction of the growth lines, developed on the base of the body in front of the tubercles. Other spiral ornamentation in the form of lirae, cords, and grooves commonly developed and becoming increasingly prominent toward the anterior portion of the shell. Growth sculpture strong. Sutures commonly obscured by the backward lapping of the callus upon the preceding whorl. Aperture wide, elliptical, channeled posteriorly. Outer lip sharp, the margin frilled in those species in which the spirals are strong, the extremities of the noded spirals reflected as indentations, and the basal groove as a small dentate process. Parietal wall smoothly excavated, the lip widely reflected, nonplicate. Anterior canal short, flexed sharply, the margins parallel, the extremity emarginate. Anterior fasciole elevated, rugose, cut off from the base of the body by a concave neck which is little or not at all sculptured. Umbilicus closed by the reverted inner lip.

The figured specimen of the genotype (U. S. Nat. Mus. 326445) is from Barton, England.

Three species were included by Conrad in his original list—the genotype, *Murex minax* Solander



in Brander, *Monoceros armigerus* Conrad, cited as the genotype by Palmer, and *Melongena crassicornuta* Conrad, described from the Vicksburg and apparently a true *Melongena*. *Cornulina* is commonly given subgeneric rank under *Melongena*. The two groups have in common two series of spinose tubercles upon the body, but there is no well-defined neck in *Melongena* and no basal groove, and the pillar in *Melongena* is less sharply deviated anteriorly and much more compressed than it is in *Cornulina*. Dall characterized Conrad's *armigera* as "a tuberculated *Pseudoliva*." *Cornulina* has much in common, too, with *Lacinia* but is less crudely formed, as a rule, than the species of either *Pseudoliva* or *Lacinia*; the anterior canal, though short, is distinct; the spire is higher as a rule; and irregularities in the backwash of the callus are less commonly developed in *Cornulina*.

*Cornulina* is apparently a cachet of the Eocene epoch. The characters of the genus seem to have been unusually stable. The genotype has been reported from the upper Eocene of England and of France and from Nigeria (Bullen Newton, R., Geol. Survey Nigeria, Bull. 3, p. 35, pl. 3, figs. 6, 7, 1922). The name has probably been used too loosely, but at least it indicates the wide distribution of a well-characterized race.

#### Group of *Cornulina armigera* Conrad

(Plate 20, figures 2, 3, 7, 8; Plate 21, figure 1)

- 1833. *Melongena? armigera* CONRAD, Fossil shells of the Tertiary formations of North America, no. 3, p. 30.
- 1833. *Monoceros armigera* CONRAD, Fossil shells of the Tertiary formations of North America, no. 4, p. 44.
- 1833. *Fusus Taitii* LEA, Contributions to geology, p. 152, pl. 5, fig. 159.
- 1835. *Monoceros armigerus* CONRAD, Fossil shells of the Tertiary formations of North America, republication of no. 3, p. 37, pl. 15, fig. 1.
- 1853. *Cornulina armigera* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 6, p. 321.
- 1853. *Monoceros armigerus* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 6, p. 321.
- 1853. *Melongena armigera* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 6, p. 321.
- 1853. *Fusus Taitii* Lea. CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 6, p. 321.
- 1865. *Cornuliria* (error for *Cornulina*) *armigera* CONRAD, Am. Jour. Conchology, vol. 1, p. 21.
- 1865. *Fusus Taitii* Lea. CONRAD, Am. Jour. Conchology, vol. 1, p. 21.
- 1866. *Cornulina armigera* CONRAD, Smithsonian Misc. Coll., vol. 7, no. 200, p. 17.
- 1881. *Cornulina armigera* Conrad. TRYON, Man. Conchology, vol. 3, p. 102.
- 1881. *Fusus Taitii* Lea. TRYON, Man. Conchology, vol. 3, p. 102.
- 1884. *Cornulina armigera* Conrad. FISCHER, Manuel Conchyliologie, p. 621.
- 1890. *Pseudoliva* (*Monoceros*) *armigera* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 118.
- 1890. *Cornuliria armigera* Conrad. DE GREGORIO, Annales géologie paléontologie, vol. 7, p. 111, pl. 8, figs. 48-50, pl. 9, fig. 3.
- 1894. *Cornuliria armigera* Conrad. COSSMANN, Annales géologie paléontologie, vol. 12, p. 35.
- 1895. *Cornulina armigera* Conrad. HARRIS, Bull. Am. Paleontology, vol. 1, no. 1, p. 6.
- 1895. *Fusus taitii* Lea. HARRIS, Bull. Am. Paleontology, vol. 1, no. 1, pp. 6, 44.
- 1895. *Cornulina armigera* Conrad. VAUGHAN, Am. Geologist, vol. 15, p. 213.
- 1895. *Cornulina armigera* Conrad. KENNEDY, Acad. Nat. Sci. Philadelphia, Proc. for 1895, pp. 117, 118, 123, 125.
- 1901. *Cornulina armigera* Conrad. COSSMANN, Essais Paléoconchologie Comp. vol. 4, p. 87.
- 1906. *Cornulina armigera* Conrad. VEATCH, U. S. Geol. Survey, Prof. Paper 46, pl. 19, fig. 6.
- 1909. *Cornulina armigera* Conrad. WHEELER, Nautilus, vol. 22, p. 98.
- 1914. *Cornulina armigera* Conrad. DEUSSEN, U. S. Geol. Survey, Water-Supply Paper 335, p. 65, pl. 5, fig. 6.
- 1920. *Cornulina armigera* Conrad. DUMBLE, Univ. Texas Bull. 1869, p. 92.
- 1924. *Cornulina armigera* Conrad. DEUSSEN, U. S. Geol. Survey, Prof. Paper 126, pl. 15, fig. 5.
- 1931. *Cornulina armigera* Conrad. RENICK AND STENZEL, Texas Univ. Bull. 3101, pp. 102, 107.
- 1932. *Cornulina armigera* Conrad. TROWBRIDGE, U. S. Geol. Survey, Bull. 837, pl. 38, fig. 6.
- 1933. *Cornulina armigera* Conrad. PLUMMER, Texas Univ. Bull. 3232, p. 663.
- 1935. *Cornulina armigera* Conrad. LONSDALE, U. S. Geol. Survey, Water-Supply Paper 676, p. 32.
- 1937. *Cornulina minax armigera* (Conrad). PALMER, Bull. Am. Paleontology, vol. 7, p. 339, pl. 41, figs. 12, 14, 15.
- Not *Cornulina armigera* Conrad. ALDRICH, Geol. Survey Ala., Bull. 1, pt. 1, pp. 50, 53, 1886.
- Not *Cornulina armigera* Conrad. HARRIS, Bull. Am. Paleontology, vol. 2, no. 9, pp. 29, 31, 1897. Not *Cornulina armigera* Conrad. HARRIS, Bull. Am. Paleontology, vol. 3, no. 11, pp. 63, 64, pl. 8, figs. 8-11, 1899.
- Not *Cornulina armigera* Conrad. GARDNER, Am. Jour. Sci., 5th ser., vol. 7, p. 144, 1924.
- Not *Cornulina armigera* Conrad. PLUMMER, Texas Univ. Bull. 3232, p. 582, 1933.



"Shell subglobose, ponderous; body whorl with a double row of short, thick spires, [spines] one on the shoulder, the other near the middle; three or four strongly impressed lines towards the base; columella and lip callus; basal emargination profound, spire subconical, convex, constituting nearly half of the shell, the humeral spires revolving upon it. Length  $2\frac{1}{2}$  inches. Breadth 2 inches.

"Locality, Claiborne, Alab.

"Cab. Acad. N.S." Conrad, 1833.

A complete bibliography of *Cornulina armigera* would include more than 60 entries. The shell is large and well characterized and has been commonly figured in plates of representative fossils of the Claiborne.

Palmer speaks of the longer canal of the lower Claiborne individuals. The gerontic tendencies, longer spines, a backwash of callus over the spire, and the extreme development of the anterior fasciole are more marked in the individuals from the Gosport sand than in the majority of individuals from the lower Claiborne of the western Gulf. Specimens from the section along the Sabine River, Sabine County, Texas, however, presumably from 10 to 20 feet below the base of the Cook Mountain, exhibit a remarkably strong and regular development of the spines and an excess of callus upon the spire directly in front of the suture. The figured individual (Plate 20, figures 7, 8), U. S. Nat. Mus. 494950 from U.S.G.S. sta. 11104, is 55 millimeters high and 40 millimeters in greatest diameter, exclusive of the spines. If the spines are included, the diameter is 49 millimeters. The largest specimens come from Mexico. The species is abundantly represented in the fauna at Arroyo Chacon on the eastern edge of Laredo and is common only at that horizon. Probably a series of well-preserved individuals, if compared with a topotypic series, would show differences of taxonomic value.

Two examples from the Mier sector have been figured: U. S. Nat. Mus. 494971, from U.S.G.S. sta. 13465, is 72 millimeters high and 50 millimeters in greatest diameter; the larger, incomplete form, U. S. Nat. Mus. 497134 from U.S.G.S. sta. 13981, may have reached 100 millimeters in height and, if the spines are included, an equal diameter.

DISTRIBUTION: Laredo formation: U.S.G.S. sta. 13378,  $\frac{1}{2}$  mile above mouth of Arroyo Manados; U.S.G.S. sta. 2112, Arroyo Chacon, Laredo, Webb County; U.S.G.S. sta. 13191,  $2\frac{1}{2}$  miles northwest of Zapata-Webb County line, Texas. Mexico: Laredo formation: middle Laredo, U.S.G.S. sta. 13465 (G-4); U.S.G.S. sta. 13984 (H-6); U.S.G.S. sta. 13981 (H-6); U.S.G.S. sta. 13555 (H-14); U.S.G.S. sta. 13547 (I-14); U.S.G.S. sta. 13554 (I-14), upper Laredo, U.S.G.S. sta. 13945 (H-3).

Subgenus *Revilla* Gardner, n. subgen.

TYPE: *Cornulina (Revilla) lita* Gardner, new species.

Shell rather small for the genus but similar in general outline to *Cornulina s. s.* Nuclear characters not known. Whorls of spire tabulated, the shoulder on the later whorls approximately horizontal and almost equal in width to the height of the whorl. Base of body and short, broad anterior canal smoothly and obliquely concave. No axial sculpture other than incremental. No spiral sculpture other than a narrow groove girdling the base of the body, so shallow that it is indicated most clearly by the abrupt change in the direction of the growth lines. Periphery corded on the spire, the cord increasing in prominence and on the body developing into a prominent flange upon which the growth lines are especially strong and which exhibits an irregular outline that may be due to obscure crenation. Aperture pyriform. Outer lip expanded medially. Anterior canal and pillar short, feebly flexed. Anterior fasciole elevated, strongly arcuate. Umbilical chink partially closed by the labial callus.

The shells segregated under the subgenus *Revilla* suggest a rather small but otherwise normal *Cornulina* from which the outer sculptured surface has been removed.

It is known from the single species and from the single locality.

*Cornulina (Revilla) lita* Gardner, n. sp.

(Plate 20, figures 4, 6)

Shell small for the genus. Spire of moderate height, the apical portion lost, the 3 remaining volutions tabulated and rapidly increasing in diameter. Shoulder on whorls of spire nearly horizontal, the width about equal to the height of the whorl; on the body, gently sloping; the periphery on the spire corded, on the body pinched into a thick wide flange with a rugose and crudely crenate margin. A shallow groove girdling the base of the body; indicated chiefly by the abrupt change in the direction



of the growth lines. Shell smoothly and obliquely concave from the basal groove to the raised margin of the anterior fasciole. No sculpture other than growth striae developed. Suture impressed, feebly channeled. Aperture obliquely pyriform, moderately wide, the characters obscured by the indurated matrix with which the shell is filled. Outer lip expanded; little or not at all produced posteriorly. Inner lip broadly and gently constricted at the base of the body. Parietal wall moderately heavy with a well-defined outer limit. Pillar gently flexed. Anterior fasciole strongly arcuate and rugose. Umbilical chink between the fasciole and the pillar not entirely closed by the reverted lip.

DIMENSIONS OF IMPERFECT HOLOTYPE: Height, 36.5 millimeters; diameter, 33.3 millimeters.

HOLOTYPE: U. S. Nat. Mus. 494954.

TYPE LOCALITY: U.S.G.S. sta. 13228, banks of the Rio Salado, Guerrero, Tamaulipas, Mexico. Mount Selman formation, probably very close to the base.

*Cornulina* (Revilla) *lita* is remarkable among all the described members of the genus for the simplicity of ornamentation. The superficial character of the shell, exclusive of the canal, and the height of the spire recall *Surculites* rather than *Cornulina*, and the shell suggests a mold of *Cornulina* rather than the noded and spirally grooved and corded shell which commonly represents that genus. The species is known only from the type locality.

#### Genus *Lacinia* Conrad

1853. *Lacinia* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 6, p. 448.

TYPE, BY MONOTYPY: *Melongena alveata* Conrad. Claiborne, Alabama.

"Globose; pillar lip widely reflected, callus; basal emargination profound; base dilated." Conrad, 1853.

*Lacinia* makes its sudden appearance in the middle of the Eocene and apparently did not survive its close. The genotype was first described as *Melongena*, and the genus has since been shuttled about from the Buccininae to the Cominellinae. The shell resembles *Pseudoliva*, but the characteristic groove at the base of the body is not developed. It also rather vaguely recalls *Cornulina* but is not constricted at the base of the body and lacks the spinose axial sculpture characteristic of that genus. On the whole, however, *Lacinia* seems to have more in common with the Melongeninae than with the Buccininae which are basally constricted, and more with the Buccininae than with the relatively high-spined and basally constricted Cominellinae.

#### *Lacinia santander* Gardner, n. sp.

(Plate 21, figures 2, 8, 9, 10)

1857. *Cassidula* (*Lacinia*) *alveata* CONRAD IN EMORY, U. S. Mexican Boundary Survey Rept., vol. 1, pt. 2, p. 163, pl. 19, figs. 9, 9a, 9b.

Not *Melongena alveata* CONRAD, 1833.

Shell reaching a very large size, rudely ovate; body enveloping the spire in the adult; in the senile forms, such as that indicated in Figures 2 and 8 of Plate 21, almost entirely concealing it. Earliest whorls lost in all available material. Nucleus probably small and paucispiral. Whorls of spire buccinoid, increasing rapidly in diameter; only a portion of the shoulder visible behind the suture. Body large, inflated, in the adult, almost as high as the entire shell. Sculpture of girdling bands and at the base of the body coarse lirations, fairly strong and regular in the immature forms, becoming with age irregular and obscure; the two posterior fillets outlining an obscure, bicarinate periphery; the area between the fillets feebly concave and almost as wide, in many individuals, as the space between the posterior fillet and the suture line; two other slightly less prominent and less distantly spaced bands encircling the medial portion of the body; anterior fillet separated from the basal lirae by an interval approximately equal to that between the fillets; usually 3 coarse lirae, crowded behind the rugose umbilical keel. Axial sculpture absent except for the incrementals which, in the adult, are markedly rugose toward the suture and the umbilicus. Suture channeled, the channel increasingly pronounced toward the aperture and, in many of the senile forms, dropping forward out of the regular plane of coiling. Callus heavy toward the aperture, banking in front of the suture, and forming a narrow shoulder, which on the adult forms is sharply defined by the change in the direction of the growth lines. Aperture obliquely lenticular. Outer lip broadly arched, cut off by a



narrow channel from the thick heavy callus pad at the posterior commissure. Parietal wash also heavy medially and anteriorly; the outer margin sharply defined; callus overriding the umbilical keel, completely closing the umbilicus and merging anteriorly with the pillar wash. Anterior fasciole corrugated, broadly U-shaped at the extremity, forming an outer umbilical keel, separated by a narrow rugose area from the inner keel which usually marks the outer line of the umbilical callus.

**DIMENSIONS OF HOLOTYPE:** Height, 51.4 millimeters; diameter, 48 millimeters. Dimensions of imperfect juvenile paratype: Height, 38.4 millimeters; diameter, 25.7 millimeters. Dimensions of senile paratype: Height, 80 millimeters; diameter, 73 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 9901. **Juvenile paratype:** U. S. Nat. Mus. 497139. **Senile paratype:** U. S. Nat. Mus. 497135.

**TYPE LOCALITY:** "Western Texas", probably from the vicinity of Laredo, Webb County, Texas. **Locality of juvenile paratype:** U.S.G.S. sta. 13943 (H-3), 1300 meters N. 80° W. from the church tower in Mier, Tamaulipas. **Locality of senile paratype:** U.S.G.S. sta. 13565 (H-12), 4750 meters S. 74° E. of Doctor Cos on west side of Loma Guajardo road, Doctor Cos, Nuevo León.

The holotype is the individual figured by Conrad in the United States and Mexican Boundary Report.

The distribution of *Lacinia santander* and its possible descendant *L. alveata* is remarkable. From no recognized ancestry, *Lacinia santander* abruptly appears as one of the major elements in the gastropod faunas in the middle and upper part of the Laredo formation of the western Gulf region. The species has the aspect of a long-established form. It offers a wide range in variation, and many of the individuals exhibit marked senility. It seems to have been sensitive to temperature conditions for no typical examples have been found north of the Rio Grande province, and there is no record of it in the lower Claiborne of the eastern Gulf region. In the Gosport sand, the closely allied *Lacinia alveata*, which may well be in the direct line of descent from *santander* or may represent a lateral stock, offers a similar range of variation and rivals in abundance the earlier western species. The later form differs in the less depressed, usually wider, more sloping shoulder, the more obscure bands girding the body, and the more shallow sutural channel developed at a later stage than in *santander*.

**DISTRIBUTION:** Mount Selman formation: U.S.G.S. sta. 13664 (E-12), a single specimen. Laredo formation: middle Laredo. U.S.G.S. sta. 13986 (G-2); U.S.G.S. sta. 13772 (G-3); U.S.G.S. sta. 13790 (G-4); U.S.G.S. sta. 13981 (H-6); U.S.G.S. sta. 13685 (H-9); U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13590 (I-13); U.S.G.S. sta. 13592 (I-13); U.S.G.S. sta. 13554 (I-14); upper Laredo, U.S.G.S. sta. 13987 (H-3); U.S.G.S. sta. 13943 (H-3); U.S.G.S. sta. 13958 (H-3), U.S.G.S. sta. 13947 (H-3).

#### Family BUSYCONIDAE

##### Genus *Busycon* (Bolten) Roeding

1798. *Busycon* (Bolten) ROEDING, Museum Boltenianum, pt. 2, p. 149.

**TYPE, BY SUBSEQUENT DESIGNATION** (Herrmannsen, Indicis generum malacozoorum, Primordia, vol. 1, p. 149, 1846): *Busycon muricatum* Roeding = *Murex aruanus* Linnaeus = *Murex carica* Gmelin. Recent on the East Coast from Cape Cod to Saint Thomas.

Shell large, heavy, pyriform; the low spire terminated by a paucispiral, papillate nucleus. Body whorl very large, inflated. Pillar long and slender. Spiral sculpture generally developed. Axial sculpture usually in the form of more or less exaggerated growth lines and resting stages, often tuberculate or spinose on the periphery of the whorl. Aperture pyriform. Anterior canal long, open, recurved.

The genus, initiated in the Cretaceous, is represented in the Eocene by small and rather thin-shelled species. These rapidly evolve, however, into the large and ponderous conchs that constitute one of the most conspicuous elements in the East Coast Tertiary faunas, particularly of the Middle Atlantic States. The recent "whelks" are restricted to a few prolific species and are among the most prominent and best characterized denizens of the Atlantic shores. Both the Tertiary and Quaternary forms are confined to the eastern Atlantic coast. Probably their limited distribution is, in large measure, due to the loss of the velum before the animal emerges from the egg capsule.



*Busycon spiniger* (Conrad)

- Jan., 1848. *Fusus spiniger* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 286.  
 Aug., 1848. *Fusus spiniger* CONRAD, Acad. Nat. Sci. Philadelphia Jour., 2d ser., vol. 1, pt. 2, p. 117, pl. 11, fig. 32.  
 1867. *Fulgur spiniger* Conrad. GILL, Am. Jour. Conchology, vol. 3, p. 147.  
 1867. *Busycon spiniger* CONRAD, Am. Jour. Conchology, vol. 3, pp. 184, 185.  
 1890. *Fulgur spiniger* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 109, (part).

"Fusiform, with revolving lines, and a series of elevated acute spines on the angle of the large whorl; the series continued on the whorls of the spire near the suture; two upper whorls entire; sides above the tubercles flattened, with the revolving lines fine and indistinct; volutions seven; beak produced; labrum striated within. Length  $1\frac{3}{4}$ . Very rare." Conrad, 1848.

The type was collected "from the vicinity of Vicksburg, Mississippi."

Crushed specimens from the Oligocene sandstones in Carlos Cantú are very close to Conrad's species. They seem to differ consistently in the slightly lower spire and in a suture which winds directly in front of the nodose or spinose periphery. There is a considerable range of variation in the Vicksburg individuals, but in most of them a narrow but appreciable interval separates the periphery and the suture in front of it.

The Mexican specimens were collected at U.S.G.S. sta. 13539 (N-17) in the ashy bed at the base of the upper Middle Oligocene sandstone.

Genus *Sycotypus* Gill

1867. *Sycotypus* GILL, Am. Jour. Conchology, vol. 3, p. 147.

TYPE, BY ORIGINAL DESIGNATION: *Murex canaliculatus* Linnaeus.

Recent, East Coast from Cape Cod to Florida.

The name has been commonly credited to Browne, who applied it to "the smaller, hairy fig-shell" (*Civil and Natural History of Jamaica*, p. 406, 1756). It is uncertain from Browne's description whether he was referring, as Gill maintained, to *S. canaliculatus*, which has not been elsewhere recorded from Jamaica, or, as Gray maintained (*Zool. Soc. London, Proc.*, p. 135, 1847), to *Pyrula*, which is not hairy. However, that question is purely academic since Browne was not binomial. Gray merely cited Browne's name as a synonym of Lamarck's *Pyrula*, so that it was still available in 1867 when Gill designated the type and described the genus.

Like *Busycon*, *Sycotypus* is restricted in its distribution to the Cenozoic faunas of the east coast of North and Central America.

The Recent canaliculate whelks may be grouped about the Florida species *Sycotypus pyrum* Dillwyn, which does not range north of Hatteras, and the genotype, the common whelk of the cooler waters. The lower and middle Miocene representatives are apparently members of the *S. pyrum* group. *S. aepynotus* Dall, from the relatively cool-water deposits of the Upper Miocene, may be a precursor of the genotype.

*Sycotypus* sp.

A mold from the Guajalote formation at U.S.G.S. sta. 13588 (W-30) must easily have reached 100 millimeters in length and 55 in diameter. The sculpture is not preserved, but the record of the genus in the Miocene of northeastern Mexico is interesting. Traces of about 10 peripheral nodes at the margin of the wide and almost horizontal shoulder are discernible. Smaller molds probably referable to *Sycotypus* are fairly common at U.S.G.S. sta. 13455 (W-29).

## Family FUSINIDAE

Genus *Falsifusus* Grabau

1904. *Falsifusus* GRABAU, Smithsonian Misc. Coll., vol. 44, no. 1417, p. 80.

TYPE, BY ORIGINAL DESIGNATION: *Fusus ottonis* Aldrich = *Fusus meyeri* Aldrich, 1886, not *Fusus meyeri* DUNKER, 1871. Midway of Alabama.

"Shells fusiform, with a long and slender spire, and a canal of about the same length. Protoconch merging into the whorls of the conch, no sharp line of demarkation being apparent. The first two



whorls of the protoconch are generally smooth, the apical one minute, gradually increasing in size. The three to four whorls which constitute the apical series form a rather narrow cone. Third whorl with fine closely crowded, more or less oblique riblets, which in part are gently concave forward. These after the completion of the third, or sometimes an additional whorl, quickly merge into the normal whorls of the conch. A basal carina usually marks the ribbed whorls of the apical series, this carina appearing just above the suture. Whorls of the conch as in *Fusus*." Grabau, 1904.

The similarity of the early stages of *Falsifusus* and of the turrids has suggested the derivation of the Eocene fusoids from the turrids.

The protoconch of true *Fusus* is paucispiral, commonly of one obliquely erect, smooth, and swollen whorl succeeded by half a volution which is finely ribbed axially and which is not appreciably greater in diameter than the initial volution. The fusoids, including *Falsifusus*, do not, as a rule, develop the flattened and closely appressed area in front of the posterior suture that is exhibited by most turrids and *Latirus*.

The Fusinidae, Xancidae, and Fasciolaridae seem to form a group sufficiently apart from Buccinacea Thiele and Volutacea Thiele to merit a distinct name.

*Falsifusus bastropensis* (Harris)

1895. *Fusus bastropensis* HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 71, pl. 7, fig. 2.  
 1896. *Fusus bastropensis* Harris. VAUGHAN, U. S. Geol. Survey, Bull. 142, p. 41.  
 1899. *Fusus ludovicianus* JOHNSON, Acad. Nat. Sci. Philadelphia, Proc., p. 72, pl. 1, fig. 5.  
 1904. *Falsifusus ludovicianus* (Johnson). GRABAU, Smithsonian Misc. Coll., vol. 44, no. 1417, p. 82, text fig. 6, pl. 18, fig. 1.  
 1937. *Falsifusus bastropensis* (Harris). PALMER, Bull. Am. Paleontology, vol. 7, p. 353, pl. 48, figs. 6, 10, 11.

"Size and general form as indicated in the figure; whorls 13 or 14; 1 and 2 very minute, smooth, 3 and 4 transversely costate, 5-12 with nodose obtuse ribs, distinct in 5, 6, etc., but less marked in 11 and 12, crossed by six or seven spiral raised lines, coarse or strong near the base of each whorl; one spiral line, generally the second from the base forms a slight carination on the whorls; body whorl with broad nodulations, about seven in number, and with strong spiral raised lines, the two on the largest part of the whorls being largest, above which there are two or three well-marked lines and below which to the end of the canal the lines gradually decrease in size and are more or less alternating; labrum, as far as observed, non-striate within; columella long, smooth, and straight.

"This resembles somewhat *F. meyeri* Ald.

"Localities.—Smithville, Bastrop Co., Tex. Also in Claiborne and Bienville Parishes, La.

"Geological horizon.—Lower Claiborne Eocene.

"Type.—Coll. of G. D. Harris." Harris, 1895.

The height of the specimen figured by Harris is about 31.5 millimeters, and the diameter, about 9 millimeters.

"The protoconch of this species [*Falsifusus ludovicianus* (Johnson)] agrees in essential characters with that of *F. meyeri*. The first two whorls are smooth and gradually increase in size. The next whorl is marked by oblique narrow smooth riblets essentially as in *F. meyeri*. This is followed by the normally round-ribbed and spirally marked whorls, which with but slight modification continue to the adult stage. The shoulder is slightly flattened, but there is no pronounced angulation or carination of the whorl. It is, however, more bulging in the center than is normal in rounded-whorled species of Fusoid shells.

"Locality: Louisiana, St. Maurice, Winn Parish (Johnson); Phil. Acad.—(U. S. Nat. Mus. 147226).

"Horizon: Eocene, Lower Claiborne." Grabau, 1904.

A few slender, multiwhorled spires, with the periphery falling far forward so that the anterior suture is overhung, have been recovered from the lower Laredo at U.S.G.S. sta. 13596 (H-15). Very large and fine *Ostrea sellaeformis* and prolific *Balanophyllia* and other solitary corals are associated with the *Falsifusus*. The horizon is, according to the field determination, not more than 100 feet above the base of the Laredo formation.

*Falsifusus* sp.

Two spires (U. S. Nat. Mus. 497432) of a multiwhorled, exceedingly slender species were recovered from the lower Laredo formation at U.S.G.S. sta. 13600 (H-15). The early whorls recall those of *Falsifusus bastropensis* (Harris), from the same horizon. The protoconchs are missing on both specimens. The early whorls of the conch are rippled with 6 to 8 axial costae, overridden by 4 or 5



spiral cords, of which the second spiral from the anterior suture is the strongest. On about the sixth whorl, the axials die out, and the whorls assume an angular outline, owing in large part to the increasing prominence of the next to the anterior spiral that outlines the periphery. The shoulder ramp behind the periphery is steep, and two spirals less elevated than the peripheral spiral are symmetrically disposed upon it. There is one moderately strong spiral between the periphery and the anterior suture. The body is similar in general character to the whorls of the spire and not very much larger, proportionally. The characters of the aperture and of the anterior canal are not known. The perfect shell probably measured between 20 and 25 millimeters in height, and the diameter of the larger specimen is about 5 millimeters. No other species is closely comparable.

*Falsifusus mortoniopsis* (Gabb)

(Plate 27, figure 18)

1860. *Fusus mortoniopsis* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 377, pl. 67 fig. 15.  
 1865. *Fusus mortoniopsis* Gabb. CONRAD, Am. Jour. Conchology, vol. 1, p. 16.  
 1891. *Fusus mortoniopsis* Gabb. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, p. 395.  
 1895. *Fusus mortoniopsis* Gabb. VAUGHAN, Am. Geologist, vol. 15, pp. 213, 217.  
 1895. *Fusus mortoni* var. *mortoniopsis* Gabb. HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 72, pl. 7, fig. 4.  
 1896. *Fusus mortoni* Lea var. *mortoniopsis* Gabb. VAUGHAN, U. S. Geol. Survey, Bull. 142, pp. 17, 41.  
 1920. *Fusus mortoni* var. *mortoniopsis* Gabb. DUMBLE, Univ. Texas Bull. 1869, pp. 92, 94, 96, 97, 98, 100, 107.  
 1931. *Fusus mortoni* Lea var. *mortoniopsis* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 96, 101, pl. 7, fig. 16.

"Scalariform; whorls eight, angular and prominent; spire nearly as long as the aperture; aperture elongated angular above, canal long, straight, narrow; surface marked by about seven or eight prominent longitudinal ribs, crossed on the shoulder of the whorl by three fine revolving lines, and on the rest of the whorl by six or seven larger lines, with occasional finer ones alternating; on the canal, the alternation of one or two fine lines with a larger one appears to be constant.

"*Dimensions*.—Length 1.4 in., width of body whorl .65 in., length of aperture including canal .8.

"*Locality*.—Wheelock and Caldwell Co., Texas. Collections of the Smithsonian Institution and the Academy and my collection.

"This species resembles *F. mortoni*, Lea, but differs in the alternation of finer lines with the larger ones and in being proportionally more slender." Gabb, 1860.

HOLOTYPE: Acad. Nat. Sci. Philadelphia 13281.

DIMENSIONS OF IMPERFECT SPECIMEN FIGURED: Height, 22 millimeters; diameter, 10.5 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 497267.

LOCALITY OF FIGURED SPECIMEN: U.S.G.S. sta. 13454 (H-15).

Gabb's illustration does not sufficiently indicate the sharpness of the constriction at the base of the body. The extreme tip of the holotype is lost. One whorl of the small protoconch and an almost perfect conch of 7 whorls remain. The whorls of the spire and body are girded with 3 rather narrow fillets, and on the base of the body, 3 additional spirals. There are also 2 finer lirae on the shoulder. The pillar is closely lirate, and the threads tend to alternate in size.

The later whorls of *Falsifusus carexus* are conspicuously angulated at the periphery, but in *F. mortoniopsis* the carinal cord is less strongly developed, and the shoulder less clearly differentiated. Gabb's species is characteristic of a horizon lower than that in which *carexus* occurs and in Nuevo León is restricted to the basal and lower parts of the Laredo formation.

DISTRIBUTION: Laredo formation: lower Laredo, U.S.G.S. sta. 13564 (H-12); U.S.G.S. sta. 13563 (H-12); U.S.G.S. sta. 13454 (H-15); U.S.G.S. sta. 13600 (H-15); U.S.G.S. sta. 13596 (H-15); U.S.G.S. sta. 13618 (H-17); U.S.G.S. sta. 13617 (H-18).

*Falsifusus carexus* (Harris)

(Plate 27, figure 11)

1895. *Fusus mortoni* Lea var. *carexus* HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 72, pl. 7, fig. 5.  
 1931. *Fusus mortoni* Lea var. *carexus* Harris. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 96, 101, pl. 7, fig. 17.



"Differs from *mortoniopsis* Gabb, which is doubtless a variety only of *mortoni* Lea, by having a strong carina, one additional spiral line on the shoulder and less strongly alternating on the canal. The shell is much broader in proportion to its height and has a lower spire.

"*Locality*.—Between Orell's and Evergreen Crossing, Elm Creek, Lee Co., Tex.

"*Geological horizon*.—Lower Claiborne Eocene.

"*Type*.—Texas State Museum." Harris, 1895.

The earlier, less angular whorls of the spire may resemble those of *mortoniopsis*, but on the later volutions the strength of the peripheral carina is sufficiently great to isolate the species. Along the Brazos River and in Lee County, where both *carexus* and *mortoniopsis* commonly occur, Stenzel found that *carexus* was restricted to a zone from 2 feet below the "Little Brazos Limestone" to about 20 feet above it. In Mexico, *carexus* and *mortoniopsis* have not been found in association; the former occurs only in the middle part of the Laredo formation, *mortoniopsis* only in the lower horizon.

DIMENSIONS OF IMPERFECT FIGURED SPECIMEN: Height, 20 millimeters; diameter, 12 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 497269.

LOCALITY OF FIGURED SPECIMEN: U.S.G.S. sta. 13565 (H-12). Middle part of Laredo formation.

DISTRIBUTION: Laredo formation; lower Laredo, ?U.S.G.S. sta. 13968 (I-19), middle Laredo, U.S.G.S. sta. 13861 (H-4); ?U.S.G.S. sta. 13978 (H-5); ?U.S.G.S. sta. 13984 (H-6); ?U.S.G.S. sta. 13557 (H-10); U.S.G.S. sta. 13567 (H-11); U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13591 (H-13); U.S.G.S. sta. 13553 (H-15); ?U.S.G.S. sta. 13643 (M-25).

#### Genus *Clavilithes* Swainson

1840. *Clavilithes* Swainson, Treatise on malacology, p. 304. Probably a substitute name for *Clavella* Swainson, 1835, genus without species. Not *Clavella* Oken, 1815; Crustacean.

TYPE, BY SUBSEQUENT DESIGNATION: Herrmannsen, Indicis Generum malacozoorum, vol. 1, p. 246, March, 1847: *Fusus Noae* Chemnitz (Lamarck). Middle Eocene of the Paris Basin.

#### *Clavilithes penrosei* (Heilprin)

(Plate 13, figure 5)

1891. *Clavella* (*Fusus*?) *Penrosei* HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc., p. 405, pl. 11, fig. 1.

1895. *Clavilithes penrosei* Heilprin. HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 73.

1937. *Clavilithes penrosei* (Heilprin)? PALMER, Bull. Am. Paleontology, vol. 7, p. 359, pl. 55, figs. 1, 3, 4, 6.

"Shell large, turbate, with a greatly elongated canal; whorls scalariform, depressed, broadly flattened and slightly hollowed on the shoulder; no revolving lines, but wrinkles of growth faintly indicated; beak nearly (or fully?) the length of the spire, and twisted at about its middle somewhat as in *Fulgur*; canal narrow, tortuous in its upper half.

"Length of full-grown specimen probably 8–10 inches.

"Station 2, Rio Grande. Fragments of two specimens." Heilprin, 1891.

The comparison of the imperfect specimen from Mexico with the illustration of an equally imperfect specimen from the Rio Grande is not very satisfactory, but they are both so very much larger than any other recognized species that a specific identity is probable. Palmer has figured another large individual from Smithville that may be *C. penrosei* but which seems from the photograph to be less angular. In any case, she is doubtless correct in her statement that Heilprin's restoration indicates too low a spire. Only the unsculptured whorls are preserved on the specimen figured in this report.

DIAMETER OF FIGURED SPECIMEN: 95.0 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 497103.

LOCALITY OF FIGURED SPECIMEN: U.S.G.S. sta. 13972 (I-20). Lower part of the Laredo formation.

The specimen figured includes only the 3 final whorls, and the anterior canal has been lost. The fragments of a rather thin shell still adhering to the body are smooth except for incremental striae. The shoulder is wide and probably concave at least on the later whorls. The sides of the whorls including the body must have been nearly vertical. An obtusely angulated keel girds the base of



the body, and in front of it the shell is obliquely constricted. The specimen was recovered from a zone of large gray calcareous concretions, probably low in the Laredo formation. A similar but even more imperfectly preserved mold was found at U.S.G.S. sta. 13597 (I-18), in the basal Laredo exposed on the old road just east of Realitos corrals, China, Carlos Cantú, Nuevo León. The stratigraphic position of these outcrops is similar to that of the specimens from Smithville figured by Palmer.

Fragments of individuals of no more than moderate dimensions are rather widely distributed in the basal Laredo.

### Family XANCIDAE

#### Genus *Xancus* (Bolten) Roeding

1798. *Xancus* (Bolten) ROEDING, Museum Boltenianum, pt. 2, p. 134.

TYPE, BY SUBSEQUENT DESIGNATION (Dall, Jour. Conchology Great Britain and Ireland, vol. 11, p. 296, 1906): *Voluta pyrum* Gmelin. Recent in the Indian Ocean.

Shell large, heavy, pear-shaped or fusiform. Spire varying in relative height from more than half to less than a third that of the entire shell. Protoconch, in the genotype, of  $2\frac{1}{2}$  smooth, rather large whorls, papillate at the apex and not increasing in diameter toward the aperture. Whorls of conch rather numerous, flattened or angulated at the periphery, closely appressed at the suture. Sculpture dominantly axial, commonly nodose, but in the genotype nearly obsolete. Anterior canal straight or very loosely sigmoidal. Outer lip strongly arcuate, not reinforced nor lirate within. Inner lip much thickened and reflected; 3 robust horizontal plaits and, in some individuals, a relatively feeble anterior fold near the base of the body. Umbilical chink occasionally visible between the canal wall and the reflected labium.

*Xancus* is separated from the Volutidae and Mitridae on the one hand and from the Fascioliariidae on the other by the development of the 3 uniformly strong, approximately horizontal folds on the medial or slightly posterior portion of the columellar wall. The protoconch is similar to that of *Clavilithes*. The genus is recorded from the Eocene of Peru, but on the Atlantic side both of America and of Europe the earliest known species are of Oligocene age. The Recent forms, the chank shells, are confined to the Indian Ocean and the Brazilian Coast. The Indian species, notably the type, are used in many of the Brahminic religious ceremonies.

#### *Xancus wilsoni* (Conrad)

1829. *Turbinella* sp., LESUEUR, Walnut Hills fossil shells, pl. 3, fig. 14.  
 Jan., 1848. *Turbinella wilsoni* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 290.  
 Aug., 1848. *Turbinella Wilsoni* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 120, pl. 12, fig. 12.  
 1865. *Mazza wilsoni* CONRAD, Am. Jour. Conchology, vol. 1, p. 23.  
 1890. *Turbinella Wilsoni* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, pp. 96, 97, 98.  
 1922. *Xancus wilsoni* (Conrad). COOKE, U. S. Geol. Survey, Prof. Paper 129-E, p. 83.

"Fusiform; spire elevated, acute, volutions ten, angular, nodose, the larger volutions somewhat concave above; the upper volutions with revolving lines, obsolete or wanting on the lower ones; beak with coarse, slightly raised revolving lines; aperture narrow; columella with three rather distant compressed plaits, the middle one largest; canal long. Length 5 inches."

"The young of this species has distinct lines on every part of the shell, except on the large portion of the body whorl, where they are indistinct and remote. This species is named to commemorate the scientific zeal of Dr. Thomas B. Wilson. It is rare, and generally very imperfect." Conrad, 1848.

Cooke records the species from the Byram marl at Leaf River, Smith County, and at Vicksburg, Miss. Most of the larger collections from Vicksburg include a few specimens. They are conspicuous by reason of the size, the high, multi-whorled spire, the long flattened body, the long anterior canal, and the 3 prominent nearly horizontal folds placed well back on the parietal wall. The whorls are compressed and slightly concave behind the periphery, but the sides of the whorls in front of the periphery are nearly vertical.

Poorly preserved specimens, not specifically determinable, but similar to *wilsoni* in outline and



dimensions, occur in the lower marine Oligocene sandstone at U.S.G.S. sta. 13509 (M-11) and in beds of Jackson age at U.S.G.S. sta. 13467 (M-11).

A species smaller, apparently, than *wilsoni* is recorded by Olsson (Bull. Am. Paleontology, vol. 14, no. 52, p. 89, pl. 21, fig. 5, 1928) from the Eocene and Oligocene of northern Peru with the comment that:

"The discovery of a typical *Xancus* in the Peruvian Eocene, extends the known stratigraphic range of this genus downward from the Lower Oligocene, into the upper part of the Middle Eocene. The *X. wilsoni* Conrad from the Vicksburg Oligocene, is similar to *peruvianus*, but it differs in having a less pronounced shoulder and the sutural area is wider."

The type of *Xancus peruvianus* comes from the "Chira shales of Lower Oligocene age," but the species has been recovered also from the Saman formation, presumably of upper Eocene age, and a few very poorly preserved specimens have also been found in the Restin sandstones of "Upper Middle Eocene age." The occurrence in the late Eocene of northeastern Mexico of a comparable species, apparently closer to *wilsoni* than the Peruvian form, indicates that the group may have evolved in the mid-American region in middle and upper Eocene time.

#### Family FASCIOLARIIDAE

#### Genus *Latirus* Montfort

1810. *Latirus* MONTFORT, Conchyliologie systématique, vol. 2, p. 531.

TYPE, BY MONOTYPY: *Latirus aurantiacus* Montfort = *Murex filiosus* Lamarck = *Murex gibbulus* Gmelin. Recent in Australian waters.

Shell small or of moderate dimensions, turreted, fusiform. Protoconch small, the early whorls smooth, polished, increasing rapidly in size; at least a part of the final nuclear whorl axially costate. Conch adorned with prominent swollen axials overridden by strong spiral lirae. Body whorl abruptly constricted at the base. Aperture obliquely lenticular. Outer lip thickened and lirate within. Low, slightly oblique folds developed upon the pillar directly behind the entrance to the canal. Parietal wall glazed; a narrow chink included between the reverted inner lip and the arched and elevated anterior siphonal fasciole.

*Latirus* is a widespread but not prolific genus from the Cretaceous onward.

#### Subgenus *Polygona* Schumacher

1817. *Polygona* SCHUMACHER, Essai d'un nouveau système des habitations des vers testacés, p. 241.

TYPE, BY MONOTYPY: *Polygona fusiformis* Schumacher = *Murex infundibulum* Gmelin. (Recent in the West Indies.)

The subgenus *Polygona* is characterized by the relatively long, narrow, straight or slightly oblique anterior canal.

The East Coast Recent and Tertiary species of *Latirus* are all referable to *Polygona*.

#### *Latirus (Polygona) moorei* (Gabb)

(Plate 24, figure 10)

#### Synonymy and description of *Latirus (Polygona) moorei* (Gabb)

- 1860. *Fasciolaria moorei* GABB, Acad. Nat. Sci. Philadelphia, Jour., vol. 4, p. 382, pl. 67, fig. 27.
- 1865. *Cordieria Moorei* Gabb. CONRAD, Am. Jour. Conchology, vol. 1, p. 23.
- 1891. *Latirus (Cordieria) Moorei* Gabb. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. 1890, p. 396.
- 1895. *Latirus moorei* Gabb. VAUGHAN, Am. Geologist, vol. 15, pp. 213, 214.
- 1896. *Latirus moorei* Gabb. VAUGHAN, U. S. Geol. Survey, Bull. 142, pp. 17, 18, 42.
- 1920. *Latirus moorei* Gabb. DUMBLE, Univ. Texas Bull. 1869, pp. 88, 92, 96, 97, 98, 99, 100, 101, 107.
- 1924. *Latirus moorei* (Gabb). DEUSSEN, U. S. Geol. Survey, Prof. Paper 126, p. 64, pl. 22, fig. 1.
- 1931. *Latirus moorei* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 93, 101, pl. 6, fig. 13.
- 1937. *Latirus moorei* (Gabb). PALMER, Bull. Am. Paleontology, vol. 7, p. 342, pl. 54, figs. 2, 5, 9, 10, 14, 18; pl. 87, fig. 3.

"Fusiform; whorls eight, spire acuminate; mouth half the length of the shell, outer lip crenate within, inner lip with one tooth at the upper part, columella nearly straight, with three or four nearly



transverse folds, the anterior of which is somewhat tuberculous; surface marked by large nodes, seven on the body whorl, crossed by numerous alternating, revolving lines; suture well marked but shallow.

"Dimensions.—Length 1.5 in., length of mouth .75 in., width of body whorl .65 in.

"This may possibly be identical with *F. plicata*, Lea, but it differs from his figure in being higher, more slender and in having a straighter canal.

"This species appears to be common both at Wheelock and in Caldwell Co., Texas, but the specimens in my collection from the latter locality are of a larger average size than those from Wheelock, some of them being twice as large as any I have seen from the other locality." Gabb, 1860.

HOLOTYPE: Coll. Acad. Nat. Sci. Philadelphia 13279.

TYPE LOCALITY: Caldwell County, Texas.

The illustration is poor. The protoconch is lost, and the figure does not adequately indicate the bulging and sharply constricted body whorl, the expanded aperture, and the twisted anterior canal. Furthermore, the sutural collar and the depression in front of it are not well shown.

Gabb's figured type from Caldwell County measures 38 millimeters and is possibly from a lower bed than that in which the smaller form is abundant. An average specimen, such as that figured in the Deussen report, is 21.5 millimeters high. The species could perhaps be split with advantage to the stratigrapher, but the Mexican material would contribute nothing to the interpretation of the relationships. A number of individuals from General Bravo, Carlos Cantú, Nuevo León, which have lost both apex and anterior canal, are doubtfully referred to *moorei*. The Mexican forms may have averaged about 30 millimeters in height. The sculpture pattern is similar in the larger and smaller forms, but the specimen figured in the Deussen report, which comes from one of the glauconitic beds at Mosleys Ferry, is more sharply constricted at the base of the body, the canal is shorter and less slender, and there is a twist to the anterior fasciole which is not indicated in Gabb's figure. The Mexican specimens exhibit no secondary liration, but this may have been lost in weathering.

DISTRIBUTION: Laredo formation: lower Laredo, ?U.S.G.S. sta. 13596 (H-15); ?U.S.G.S. sta. 13971 (I-20), middle Laredo, ?U.S.G.S. sta. 13772 (G-3); ?U.S.G.S. sta. 13984 (H-6); ?U.S.G.S. sta. 13567 (H-11); U.S.G.S. sta. 13565 (H-12); ?U.S.G.S. sta. 13569 (H-12); ?U.S.G.S. 13570 (H-12); ?U.S.G.S. sta. 13590 (I-13); ?U.S.G.S. sta. 13555 (H-14); ?U.S.G.S. sta. 13547 (I-14); ?U.S.G.S. sta. 13554 (I-14); ?U.S.G.S. sta. 13553 (H-15).

#### *Latirus (Polygona) sp.*

A number of slender, high-spined individuals resembling the group of *Latirus moorei* (Gabb) in general sculpture pattern and in the contour of the whorls are associated with forms referred to that group from Carlos Cantú, Nuevo León. They may well represent a new species of *Latirus (Polygona)*. Some of the turrids such as *Surculoma penrosei* (Harris) exhibit a similar outline, but the axials are less knobby, and the spiral lirae not so strong. When the anterior canal is missing, as it usually is, the shells recall the fusoids, but the species referable to *Latirus (Polygona)* develop a sutural collar that is lacking in all the Fusinidae of the area.

DISTRIBUTION: Laredo formation: lower Laredo, U.S.G.S. sta. 13968 (I-19); middle Laredo, U.S.G.S. sta. 13567 (H-11); U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13554 (I-14).

#### *Latirus? (Polygona) neoulios* Gardner, n. sp.

(Plate 24, figure 7)

Shell small for the genus, slender, biconic, the aperture approximately half as high as the entire shell. Protoconch and earliest whorls of conch lost. The 4 remaining whorls tightly wound and banded at the suture, axially fluted with narrow protractive riblets averaging 8 to the whorl and very finely spirally striate. The compressed band in front of the suture free from axial fluting but undulated by the costae of the preceding volution. No sharp constriction at the base of the body. Aperture narrow, oblique, partially filled with matrix. No lirae evident on the inner surface of the outer lip. Pillar moderately long for the genus, bearing just in front of the base of the body 2 strong equal oblique folds which abruptly disappear at the mouth of the aperture. Pillar bent. Anterior fasciole corrugated by the growth lines and slightly swollen.

DIMENSIONS OF HOLOTYPE: Height of imperfect shell, 13.5 millimeters; diameter, 5.8 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497270.



TYPE LOCALITY: U.S.G.S. sta. 13454 (H-15). Lower part of Laredo formation.

*Latirus? neoulios* is not like any species described from the Gulf Province. It is unusually small, the axial ribs are not so swollen, and the spiral striation is much finer and more regular than that observed on the other species.

The holotype, unfortunately, is unique.

*Latirus (Polygona)?* sp.

Most of the spire of a slender, multi-whorled species was recovered from the upper marine Oligocene sandstone at U.S.G.S. sta. 13539 (N-17). The whorls are closely appressed and increase slowly in diameter; their apparent convexity is due to the medial bulge of the axials. The spiral lirae, 8 to the whorl, are substantially equal, regular in spacing, and equally sharp and prominent on the axial and the interaxial areas. There are no secondaries, and there is no increase by intercalation. The characters of the base of the body and of the aperture are lost. The protoconch has been broken away.

Only the single fragment is known. The flattened undulating area in front of the posterior suture, owing to the evanescence of the axial ribs, suggests *Latirus* rather than the fusoids. In *Latirus protractus* Conrad, 1847, a similar species but less slender, the spiral lirae are flattened, and secondaries regularly intercalated.

Genus *Mazzalina* Conrad

1860. *Mazzalina* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 295.

TYPE, BY MONOTYPY: *Mazzalina pyrula* Conrad. Eocene of Alabama.

"Turbinate, smooth; columella projecting interiorly and furnished with closely arranged, oblique, obtuse plaits." Conrad, 1860.

Dall has given *Mazzalina* subgeneric rank under *Fasciolaria* on the ground that "*Mazzalina* is a *Fasciolaria* of short, stout form with supplementary, *Latirus*-like plaits imposed on its columella" (Dall, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 105, 1890). Cossmann has considered it a subgenus of *Latirus*. The group is small and restricted almost entirely in its known distribution to the early Tertiary of the Gulf region. The representatives are few in number and often imperfectly preserved. Their general affinities are established, and the later collections throw no additional light upon their more intimate associations.

The increasing prominence anteriorly of the columellar folds allies *Mazzalina* less to *Latirus* than to *Fasciolaria*.

*Mazzalina* sp.

A very fine species of *Mazzalina*, larger than any recorded in the Gulf faunas, is represented by several examples in the collection from U.S.G.S. sta. 13754 (M-7). The age may be the lower part of the middle Jackson. Four whorls remain on the best preserved specimen, but the apex, including all the nuclear whorls, is lost. The whorls of the spire are trapezoidal and increase regularly in diameter with a hint of a tabulation in front of the suture but no other break in the conic profile. On the body whorl the tabulation is more marked, and there is a well-defined shoulder-ramp, feebly concave near the slightly raised peripheral margin. The side of the body is almost vertical, and the constriction at the base of the body so abrupt that a basal keel is feebly indicated. No sculpture other than the growth lines is to be seen. On the spire and the shoulder of the body, these are strongly retractive; on the side and the base of the body, they are feebly protractive. The sutures are faintly channeled on the early whorls, more deeply on the body. The anterior portion of the shell is not preserved on any specimen, but the posterior portion of the aperture is fairly wide and angulated at the commissure, and the parietal wall is smoothly concave and seemingly free from glaze. The largest specimen probably exceeded 50 millimeters in height, and the diameter was a little more than 30 millimeters. The relationships are obviously with *M. inaurata* Conrad and its many subspecific forms. It is, however, larger than any specimen observed in the upper Claiborne or the Jackson of the Gulf.

The same species is indicated by fragments of lower or middle Jackson age from U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7° 30' E. of Ciudad Camargo, Tamaulipas.



Section *Pineda* Gardner, n. sect.

TYPE: *Mazzalina? heilpriniana pyrobola*, Gardner, n. subsp.

The section name *Pineda* is here proposed for those species of *Mazzalina* characterized by a moderately elevated, terraced spire, a nodose axial sculpture restricted to the area in front of the shoulder, and obsolete on the later whorls, a sub-angular body, outlined at the base by a wide but not very deep groove, and a strong anterior fasciole arching away from the nonplicate, heavily callused pillar and leaving between them an umbilical chink.

The relationships have not been satisfactorily recognized. *Pineda* differs from *Mazzalina* in the noded and shouldered whorls of the spire, the distinct groove at the base of the body, the consistently nonplicate pillar, and the sharply defined, corrugated anterior fasciole. In the basal groove and the characters of the fasciole, it approaches *Cornulina*, but *Cornulina* is much larger, the spire is lower, and the spinose tubercles are strongest on the body. In *Pineda* there are none of the irregularities in the growth of the callus that are associated with other basally grooved forms, such as *Pseudoliva*, and to a lesser degree with *Cornulina*. The rather long and well-formed anterior canal does not favor its inclusion within the Buccinidae. One of the strongest arguments for the affiliation of *Pineda* with the characteristically Eocene genus *Mazzalina* is the apparent display of transitional characters in *Mazzalina dalli* Harris, from the Jackson of Arkansas. *M. dalli* exhibits a nodding on the early whorls, a kink in the growth lines at the base of the body, and a heavy growth sculpture on the anterior fasciole, though this character is much less pronounced than it is in *M. ? heilpriniana*.

Alonso Alvarez de Pineda sailed the western Gulf in 1519, at the time that the Conquistadores first entered Mexico; and it is for this early explorer that the group, seemingly rather widely distributed through the western Gulf Province, has been named.

*Mazzalina? heilpriniana* (Harris Ms.) Aldrich

1880. ———— HEILPRIN, U. S. Nat. Mus., Proc., vol. 3, pl. facing p. 150, fig. 7 (no name nor descriptive text and very poor figure).  
 1897. *Cornulina armigera* (young var.), ALDRICH, Bull. Am. Paleontology, vol. 2, no. 8, p. 6, pl. 4, fig. 4.  
 1897. *Cornulina armigera* var. *heilpriniana* Harris Ms. ALDRICH, Bull. Am. Paleontology, vol. 2, no. 8, p. 6, pl. 4, fig. 4.  
 1937. *Cornulina minax heilpriniana* Harris in Aldrich. PALMER, Bull. Am. Paleontology, vol. 7, p. 340, pl. 41, fig. 13.

"Heilprin gives no locality nor name to his figure 7, the same specimen herewith figured. Specimens in the Texas State Survey collection from Atascosa County are similarly ornamented.

'Localities.—Peeler's ranch; and S. E. of Campbellton, Atascosa County, Tex.'

"In Harris' forthcoming Bulletin on the Lignitic Stage many marked varieties of this species will be given. In the Texan report above referred to, a varietal name for the smooth form was proposed, *iz.*, var. *heilpriniana*." Aldrich 1897.

HOLOTYPE: U. S. Nat. Mus. 8918.

DIMENSIONS OF IMPERFECT HOLOTYPE: Height, 14.1 millimeters; diameter, 9.5 millimeters.

TYPE LOCALITY: unknown.

The matrix of the specimen which Heilprin figured is similar to that of "*Terebra plicifera*" which he described and figured on the same plate (U. S. Nat. Mus., Proc., 1880). The locality given for "*Terebra plicifera*" is Atascosa County, Texas. The exact locality from which Heilprin's specimens were derived is not known. Fossiliferous Jackson crops out at a number of localities in southeastern Atascosa County, but the faunule dominated by *plicifera* is remarkable for the form of preservation. Not only in Atascosa County, but in Starr County and in northeastern Mexico, the specimens are invariably silicified. This seems the more extraordinary since the individuals from the Rio Grande Embayment come apparently from an older horizon than those in Atascosa County.

The larger, less slender, and less angular variants have been segregated under the subspecies *pyrobola*.

The type remains unique.

*Mazzalina? heilpriniana pyrobola* Gardner, n. subsp.

(Plate 21, figures 3-7)

Shell moderately large for the group, the body, exclusive of the canal, squarish and including a little more than the middle third of the shell. Spire moderately elevated. Whorls shouldered.



Canal short and broad. Apical whorls not preserved on any of the numerous specimens. Conch including 6 or more volutions, the early whorls broadly convex; the shoulder, appearing in the adolescent shell, increasingly broad and well-defined toward the aperture. Axial ribbing best developed in the earlier stages, obsolete on or before the final whorl of the spire; axials broad, 10 or 11 to the whorl, prominent medially and anteriorly, evanescent posteriorly. Spiral sculpture absent or exceedingly fine on the spire, least feeble, as a rule, on the shoulder. Basal gutter broad but shallow, more obvious on the weathered than on the fresh shells; liration in front of the groove moderately coarse. Aperture oblique, pyriform, grooved posteriorly. Outer lip simple except for a few, possibly fortuitous lirations on the inner surface. Parietal callus moderately heavy with a thin pad directly in front of the commissure. Pillar reinforced by the reverted lip which closes the umbilical chink. Anterior fasciole rather inconspicuous on normal adults; sharply elevated at the posterior margin in the old shells (Plate 21, figure 5).

**DIMENSIONS OF IMPERFECT HOLOTYPE:** Height, 20 millimeters; diameter, 11.5 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 497137.

**TYPE LOCALITY:** U.S.G.S. sta. 14169, 4.1 miles northeast of Salineño, Starr County, Texas.

The specimen selected as the holotype is smaller than the average individual. The imperfect topotype, U. S. Nat. Mus. 497138, figured to show the senile characters of the anterior fasciole, is 40.5 millimeters high and 21.5 millimeters in diameter. The topotype, U. S. Nat. Mus. 497136, 17 millimeters high and 10 millimeters in diameter, illustrates a strongly sculptured adolescent.

In *Cornulina*, to which this group had been referred, the axial sculpture grows stronger with age; in the section *Pineda* the axial sculpture on the later whorls is obsolete. In the Rio Grande Embayment, the faunule of which this form is usually a part, marks a definite horizon below the heavy sandstone exposed in the high bluff at Roma. The geologists working in Texas have referred this horizon to the lower Jackson, those working in Mexico, to the upper Yegua.

The variation in the relative proportions and in the persistence of the axial sculpture is marked.

**DISTRIBUTION:** Jackson formation, lower Jackson: U.S.G.S. sta. 13997, just above basal ash bed of the Fayette south of the Sandalio Ramos Ranch about 3.5 miles northeast of Salineño, Starr County, Texas. Mexico: Upper part of the Yegua formation, U.S.G.S. sta. 13499 (I-4); ?U.S.G.S. sta. 13500 (I-4); U.S.G.S. sta. 13497 (I-4).

#### Genus *Fasciolaria* Lamarck

1799. *Fasciolaria* LAMARCK, Prodrôme d'une nouvelle classification des coquilles: Soc. hist. nat. Paris, Mém., p. 73.

**TYPE, BY MONOTYPY:** *Murex tulipa* Linnaeus. Recent on the East Coast from Hatteras to Cartagena.

Shell often very large, stout, fusiform. Spire elevated; apex acute. Nucleus smooth, paucispiral. Postnuclear whorls strongly sculptured both axially and spirally. Aperture oval-elongate, terminating in an open, more or less twisted, feebly emarginate canal. Columella concave, furnished with oblique, diminishing folds, the anterior, as in the volutes, the most prominent. Parietal wall glazed. Anterior fasciole narrow and inconspicuous. Umbilicus closed.

#### *Fasciolaria?* sp.

(Plate 15, figures 11, 12, 16)

Fairly abundant but fragmentary material, possibly related to *Fasciolaria?* species recorded from the Kincaid formation on the Indio Ranch in Maverick County (Gardner, Univ. Texas Bull. 3301, p. 247, pl. 22, fig. 4, 1935), was collected from the limestone scarp in the lower Midway, near Loma Comales, 5.5 kilometers south-southeast of Agualeguas, Nuevo León, U.S.G.S. sta. 13459 (B-6). The conchs are large with rapidly enlarging, shouldered whorls and traces of peripheral nodes and spines. A close spiral cording was developed at least on the sides and the base of the body. The body is strongly constricted, and the anterior canal may have been rather long. The figured specimens, U. S. Nat. Mus. 494972 and U. S. Nat. Mus. 495006, are from U.S.G.S. sta. 13459 (B-6). An incomplete body whorl, remarkable for the high, narrow, evenly arched axials and the crowded spiral cording but possibly falling outside this family, is represented in Figure 13 of Plate 15. It is U. S. Nat. Mus. 495016 from the undifferentiated Midway at U.S.G.S. sta. 13490 (D-18).



*Incertae sedis*

Spindle-shaped gastropods 6 to 8 centimeters long and 3 or 4 in diameter are common in the Guajalote formation at U.S.G.S. sta. 13588 (W-30). Only the molds are preserved. They indicate a conch with a scalar spire of about 5 whorls, almost horizontally tabulated, the shoulder approximately half the width of the squarish portion in front of it. The body is broadly rounded, the maximum diameter not far from the median horizontal of the shell. The constriction at the base of the body is smooth, the canal not preserved in its entirety but probably rather short and broad. The aperture is obliquely pyriform, the pillar somewhat flattened and apparently bearing a few oblique and feeble folds well up on the base of the body. The sculpture recalls that of some of the *Fasciolarias* and takes the form of spiral fillets girding the entire shell; and secondaries intercalated on the base of the body and possibly on the spire.

## Superfamily VOLUTACEA

## Family OLIVIDAE

Genus *Oliva* Martyn

1786. *Oliva* MARTYN, Universal Conchologist, vol. 3, Explanatory Table, pl. 111.

TYPE, BY SUBSEQUENT DESIGNATION (DALL, U. S. Nat. Mus., Proc., vol. 29, p. 428, 1905): *Oliva corticata* Martyn. Recent, off the coasts of Guinea.

Usually rather large, heavy, ovoid to subcylindrical shells. Substance porcellaneous. Surface polished. Spire short. Protoconch paucispiral, obtuse. Whorls of spire flattened or feebly depressed laterally, separated by channeled sutures. Aperture long and narrow, cuneate posteriorly, obliquely emarginate anteriorly. Outer lip simple, thick, almost vertical. Columellar lip subparallel to the labrum, heavily glazed, commonly wrinkled, and obliquely plicate at the mouth of the aperture.

The presence of *Oliva* in strata older than the Tertiary has not been definitely established.

The Recent species are peculiarly characteristic of the infratidal sand flats of the tropical shores.

*Oliva* sp. cf. *O. liodes* Dall

The imperfectly preserved molds of *Oliva* common in the Guajalote formation may be subspecifically related to *Oliva liodes* Dall (Wagner Free Inst. Sci., Trans., vol. 3, pt. 6, pl. 58, fig. 1) from the Chipola formation at Bailey's Ferry, Chipola River, Calhoun County, Florida. *Oliva liodes* is a member of the group of *O. sayana* Ravenel of the later Tertiary and Quaternary faunas of the south Atlantic seaboard and the West Indies. It is smaller than the Recent form and as a rule includes only 4 instead of 5 whorls in the conch. *Oliva reticularis* Lamarck, also Recent in the Floridian and West Indian faunas, is similar to *O. liodes* in the contour of the spire, but the protoconch is relatively lower and broader in *O. reticularis*, the body whorl is more rounded, and the anterior emargination is not so wide.

Molds indicating the establishment of the group of *O. liodes* Dall in the western as well as the eastern Gulf province in the lower Miocene are abundant at U.S.G.S. sta. 13584 (V-29); U.S.G.S. sta. 13455 (W-29) and U.S.G.S. sta. 13588 (W-30).

*Oliva mississippiensis* Conrad

Jan., 1848. *Oliva mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 289.

Aug., 1848. *Oliva mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 119, pl. 13, figs. 6, 38.

1865. *Lamprodroma mississippiensis* CONRAD, Am. Jour. Conchology, vol. 1, p. 22.

1922. *Olivella mississippiensis* (Conrad). COOKE, U. S. Geol. Survey, Prof. Paper 129-E, p. 83.

"Subelliptical; volutions six and a half; on the middle of the body whorl is a slightly impressed revolving line. Length 1-10. Usual size  $\frac{3}{4}$ . Abundant." Conrad, 1848.

The type is in the Academy of Natural Sciences in Philadelphia. The protoconch is rather large and blunt, the initial turn bulbous, the second and final volution narrow and laterally compressed. The conch includes 5 volutions.



*Oliva mississippiensis*, s. s., is, apparently, unrepresented in the Mexican Oligocene. The sub-specific forms are not so slender, and the whorl count seems lower by one.

*Oliva mississippiensis santander* Gardner, n. subsp.

(Plate 27, figure 12)

The Mexican Oligocene forms are smaller than *Oliva mississippiensis* Conrad s. s. (Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 119, pl. 13, figs. 6, 38, 1848) from Vicksburg, and the spire seems consistently lower and probably includes at least one less whorl. The outline, however, is more slender than that of *O. mendezensis* Gardner, and the spire higher. The channeling of the sutures is similar in the three species, and in all of them the outer lip is thin-edged and smooth within. The margin of the anterior callus band of *O. mississippiensis* and its subspecies cuts the parietal wall about one third of the distance from the commissure to the anterior extremity, but at the labrum its intersection is almost two thirds of the way down. The characters of the narrow cuneate aperture are somewhat obscured by the matrix in all the Mexican shells, but the rugose trigonal pad which reinforces the anterior portion of the inner wall is clearly shown, and, less clearly, its narrow rugose tongue produced backward along the parietal wall to the posterior margin of the callus band which girds the entire anterior portion of the body. The terminal notch of *O. santander*, like that of *O. mississippiensis*, s. s., is rather narrow, moderately deep, and obliquely directed. It is margined by a narrow thickened band which fuses with the reinforcing callus along the inner wall of the aperture.

DIMENSIONS OF HOLOTYPE: Height, 14 millimeters; diameter, 6.8 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497268.

TYPE LOCALITY: U.S.G.S. sta. 13518 (N-10).

The specimens from the lower marine Oligocene sandstone at U.S.G.S. stas. 13509, 13510, and 13511 are relatively small and short, but end members from this series can be duplicated higher in the Oligocene, and satisfactory separations cannot be made from our imperfect material. The differences may, with better specimens, prove to be of taxonomic importance.

DISTRIBUTION: Lower marine Oligocene sandstone: U.S.G.S. sta. 13505 (N-8); U.S.G.S. sta. 13518 (N-10); ?U.S.G.S. sta. 13509 (M-11); ?U.S.G.S. sta. 13510 (M-11); ?U.S.G.S. sta. 13511 (M-11); ash bed at base of upper Middle Oligocene sandstone, U.S.G.S. sta. 13539 (N-17).

*Oliva mendezensis* Gardner, n. sp.

(Plate 27, figure 8)

Shell of moderate dimensions, rudely elliptical, the spire low, the body smoothly tapering anteriorly. Apex badly eroded; apparently 5 whorls in all, the whorls of the spire narrow and increasing rapidly in diameter, separated by channeled sutures. Aperture between 2 and 3 times the height of the spire, narrow, wedge-shaped, acutely angulated posteriorly. Outer lip sharp, the characters of the interior obscured by the matrix. Anterior band of callus very wide, the margin on the parietal wall less than one third of the distance from the commissure to the anterior extremity and, on the outer lip, about midway between the extremities of the aperture. Parietal plicae restricted to wall in front of posterior margin of band; number and disposition of plicae obscured by matrix, probably about 6 or 7 oblique, subequal folds. Terminal notch narrow, deep, obliquely directed.

DIMENSIONS OF HOLOTYPE: Height, 18.4 millimeters; diameter, 8.6 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497264.

TYPE LOCALITY: U.S.G.S. sta. 13582 (0-25). Upper Oligocene sandstone.

*Oliva mendezensis* differs from *O. mississippiensis* and the subsp. *santander* in the less slender outline, the lower spire, and the broader callus band on the anterior portion of the body.

It is known from only the type locality.

Genus *Olivella* Swainson

1831. *Olivella* SWAINSON, Zoological Illustrations, 2d ser., vol. 2, pl. 58, and text.

TYPE, BY SUBSEQUENT DESIGNATION (Dall, U. S. Geol. Survey, Prof. Paper 59, p. 31, 1909): *Olivella purpurata* Swainson = *Olivella dama* Mawe. Recent off the West Coast from southern California to the Gulf of California.



## Family MITRIDAE

Genus *Mitra* Martyn

1784. *Mitra* MARTYN, The Universal Conchologist, explanatory table, vol. 1, fig. 19 (both rear and apertural views).

TYPE, BY SUBSEQUENT DESIGNATION (Dall, 1905, U. S. Nat. Mus., Proc., vol. 29, p. 284): *Mitra tessellata* Martyn. Recent in the Indo-Pacific.

Shell of moderate dimensions, rather solid, usually fusiform or rudely biconic in outline. Spire elevated as a rule, the component volutions more or less flattened laterally, gradually tapering to the small but slender and commonly polygyrate protoconch. External surface smooth, axially or spirally sculptured. Sutures impressed in the majority of forms. Aperture narrow, commonly half the length of the shell. Outer lip sharp-edged, the throat generally lirate. Columella bearing 3 to 5 folds which, unlike the plaits of the volutes, increase in prominence posteriorly. Anterior extremity emarginate or truncate.

The genus is for the most part tropical and subtropical in its distribution. The bathymetric range is rather wide, but the smaller species are largely restricted to the inshore waters. The habitat of any given group is apparently constant, certain species and sections and subgenera being reef shells, others sand burrowers, and still others burying themselves in the soft mud. The burrowing forms are commonly nocturnal.

Subgenus *Fusimitra* Conrad

1855. *Fusimitra* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., 1st ser., vol. 7, p. 261. *M. conquisita*, Con., *M. Mississippiensis*, Con., and *M. (Fusimitra) Mellingtoni* (error for *millingtoni* Conrad, 1854) Conrad listed.
1865. *Fusimitra* CONRAD, Am. Jour. Conchology, vol. 1, p. 25 (part). *F. cellulifera* Conrad, *F. conquisita* Conrad (*M. millingtoni* Conrad included under it), *F. lineata* (*Mitra*) Lea, *F. minima* (*Mitra*) Lea and *F. perexilis* (*Mitra*) Conrad listed.

TYPE, BY SUBSEQUENT DESIGNATION (Grant and Gale, San Diego Soc. Nat. Hist., Mem., vol. 1, p. 636): *Mitra "mellingtoni"* Conrad. Jackson of the Gulf Province.

"Elongate-fusiform, smooth and polished with impressed revolving lines; aperture narrow; plaits two prominent, and two obsolete, or much smaller than the others; beak elongated." Conrad, 1855.

Fischer (Manuel Conchyliologie, p. 613, 1884) and Cossmann following Fischer (Essais Paléoconchologie Comp., vol. 3, p. 166, 1899) designated *M. cellulifera* Conrad as the type, but *cellulifera* was not included until 1865.

*Mitra (Fusimitra) polita* (Gabb)

1860. *Fasciolaria polita* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 382, pl. 67, fig. 28.
1931. *Conomitra (Turricula) polita* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 101.
1937. *Fusimitra polita* (Gabb). PALMER, Bull. Am. Paleontology, vol. 7, no. 32, p. 407, pl. 66, figs. 17, 18; pl. 88, fig. 2.

"Fusiform, whorls ten, rounded, spire elevated; aperture narrow, columella short, straight, outer lip simple, crenate within, columella with three large folds and one small one, the latter the most anterior; surface smooth, with several oblique impressed lines on the lower part of the body whorl.

"Dimensions.—Length .6 in., length of mouth .27 in., width of body whorl .18 in.

"Resembles *F. elevata*, Lea; but has a longer canal and differs in the width of the mouth, the size of the folds and in the absence of all traces of teeth inside the outer lip.

"Locality.—Caldwell Co., Texas. My collection." Gabb, 1860.

HOLOTYPE: Acad. Nat. Sci. Philadelphia 13280.

*Mitra (Fusimitra) polita*, s. s., seems to be confined to the country north of the Rio Grande. The closely allied form at Smithville and in northeastern Mexico differs in the greater dimensions.

HOLOTYPE: Coll. Acad. Nat. Sci. Philadelphia 13280.

TYPE LOCALITY: Caldwell County, Texas.

The initial turn of the protoconch is lost, but the remaining shell includes 10 volutions.



*Mitra (Fusimitra) polita neta* Gardner, n. subsp.

(Plate 24, figures 1, 6)

Shell very tall and slender, the aperture only a little less than half as high as the entire shell. Spire acutely tapering; extreme tip lost, but 11 whorls remaining, the earliest, probably nuclear. Whorls closely wound and increasing regularly in diameter and height, the later volutions less compressed laterally than the earlier. Body smoothly constricted into the long and moderately slender pillar. Surface polished and unsculptured except for the feeble transverse liration on the pillar. Aperture narrow, lanceolate. Outer lip smooth and sharp. Plicae quadruplicate and closely spaced, the folds oblique, the two posterior folds stronger than those in front of them and placed well back toward the base of the body. Anterior extremity obliquely truncate.

DIMENSIONS OF HOLOTYPE: Height, 35.0 millimeters; diameter, 8.0 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497444.

TYPE LOCALITY: U.S.G.S. sta. 2586, Smithville, Bastrop County, Texas.

The specimens segregated under *Mitra polita neta* so far exceed in dimensions those described by Gabb from a higher horizon that the difference has been recognized in the taxonomy. Although a number of the specimens from Moseleys Ferry exceed the dimensions given by Gabb for *polita*, none of them reach the size commonly attained by the allied forms from the lower horizon. The Mexican individuals are imperfectly preserved, but they are all of the larger race that apparently persisted south of the Rio Grande until the middle of Laredo time.

DISTRIBUTION: Laredo formation, lower Laredo; U.S.G.S. sta. 13596 (H-15); U.S.G.S. sta. 13595 (H-15); U.S.G.S. sta. 13601 (H-16); ?U.S.G.S. sta. 13617 (H-18); ?U.S.G.S. sta. 13970 (I-19); U.S.G.S. sta. 13625 (J-20); middle Laredo, U.S.G.S. sta. 13567 (H-11); U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13570 (H-12).

*Mitra (Fusimitra) millingtoni* Conrad

(Plate 14, figure 5)

- 1854. *Mitra Millingtoni* CONRAD in WAILES, Rept. Agriculture and Geology of Mississippi, p. 289 (name only), pl. 16 (numbered XVII by error), fig. 5.
- 1855. *Mitra (Fusimitra) Mellingtoni* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., 1st ser., vol. 7, p. 261.
- 1865. *Mitra Millingtoni* CONRAD, Am. Jour. Conchology, vol. 1, p. 25. As synonym of *Fusimitra conquisita* Conrad.
- 1890. *Mitra Millingtoni* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 94.
- 1892. *Mitra Millingtoni* Conrad. DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 2, p. 229.
- 1894. *Mitra millingtoni* Conrad. HARRIS, Rept. Geol. Survey Ark. for 1892, p. 163.
- 1896. *Mitra millingtoni* Conrad. VAUGHAN, U. S. Geol. Survey, Bull. 142, p. 50.
- 1899. *Mitra (Cancilla) millingtoni* Conrad. COSSMANN, Essais paléoconchologie comp., vol. 3, p. 158.
- 1903. *Mitra millingtoni* Conrad. CASEY, Acad. Nat. Sci. Philadelphia, Proc., p. 283.
- 1931. *Mitra (Fusimitra) mellingtoni* Conrad. GRANT AND GALE, San Diego Soc. Nat. Hist., Mem., vol. 1, p. 636. Designated as the type of *Fusimitra*.
- 1937. *Mitra [Mellingtoni] Millingtoni* Conrad. PALMER, Bull. Am. Paleontology, vol. 7, no. 32, pp. 404-405.

"Profoundly elongated, fusiform; volutions ten, convex, six of which towards the apex have revolving impressed lines, with the interstices transversely striated; in the contiguous whorl they are distant and obsolete, except near the summit, where there are two distinct impressed lines; on the penultimate whorl one distinct impressed line, and the summit of the body whorl obtusely carinated; spire longer than the aperture, which is narrow; plaits four, the two superior ones very prominent, robust.

"Allied to *M. conquisita*, but much larger, proportionally longer, and with the striae less deeply impressed. It may prove, however, to be the same when many specimens from the two localities can be compared. If it should be identical with the former it is the only species common to the Vicksburg and Jackson deposits out of 40 species of the latter and 100 of the former deposit." Conrad, 1855.

HOLOTYPE AND PARATYPE: Acad. Nat. Sci. Philadelphia 13204.

DIMENSIONS OF IMPERFECT FIGURED SPECIMEN: Height of imperfect specimen, 65.0 millimeters; diameter, 27.0 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 497105.

LOCALITY OF FIGURED SPECIMEN: U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7° 30' E. of Ciudad



Camargo, Tamaulipas. Lower part of Jackson formation.

Although Conrad placed his Jackson species in the synonymy of the form he described from Vicksburg, his earlier judgment seems to have been sound. The Vicksburg species seems never to attain the dimensions frequently reached by the Jackson individuals and is usually less slender, although the type of *conquisita* does not indicate this.

DISTRIBUTION: Jackson formation: lower or middle Jackson, U.S.G.S. sta. 13504 (M-8). Lower marine Oligocene sandstone: ?U.S.G.S. sta. 13509 (M-11).

*Mitra (Fusimitra) conquisita* Conrad

- Jan., 1848. *Mitra conquisita* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 3, p. 289.  
 Jan., 1848. *Mitra mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 3, p. 289.  
 Aug., 1848. *Mitra conquisita* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 119, pl. 12, fig. 1.  
 Aug., 1848. *Mitra mississippiensis* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 119, pl. 12, fig. 2.  
 1865. *Fusimitra conquisita* CONRAD, Am. Jour. Conchology, vol. 1, p. 25.  
 1903. *Mitra conquisita* Conrad. CASEY, Acad. Nat. Sci. Philadelphia, Proc. for 1903, p. 283.  
 1903. *Mitra mississippiensis* Conrad. CASEY, Acad. Nat. Sci. Philadelphia, Proc. for 1903, p. 283.  
 1922. *Mitra conquisita* Conrad. COOKE, U. S. Geol. Survey, Prof. Paper 129-E, p. 83.

"Fusiform, slender, smooth and polished; whorls eleven, slightly convex; penultimate whorl entire, except at the summit, where there are two impressed lines forming a raised line between them; the other whorls of the spire with revolving lines, and towards the apex the intervening spaces transversely wrinkled; apex acute; body whorl above the aperture, except the lines near the suture, without striae; inferiorly striated; aperture narrow; labium 3-plaited. Length 1 4-10. Very rare." Conrad, 1848.

*Mitra conquisita* may well be in the line of direct descent from the larger and commonly more slender species widespread in the Jackson fauna, *Mitra millingtoni* Conrad. *M. conquisita* is recorded from the Red Bluff clay, the Mint Spring marl, and the Byram marl.

The few specimens in our collections from northeastern Mexico are mostly from lower Oligocene.

DISTRIBUTION: Lower marine Oligocene sandstone: U.S.G.S. sta. 13518 (N-10); U.S.G.S. sta. 13511 (M-11); upper Oligocene sandstone, U.S.G.S. sta. 13582 (O-25).

Family VOLUTIDAE

Genus *Volutocorbis* Dall

1890. *Volutocorbis* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 75.

TYPE, BY ORIGINAL DESIGNATION: *Volutilithes limopsis* Conrad. Upper Midway of the eastern and western Gulf province.

Dall introduced the name as a subgenus under *Volutilithes*.

"Shell resembling *Volutilithes*, but more slender and without a coronated shoulder; the sculpture is reticulate and nodose or prickly at the intersections; the sutural sinus is less evident than in *Volutilithes*, and the suture is sometimes channelled.

"Type V. (*Volutilithes*) *limopsis* Conrad. Lower Eocene of Alabama.

"In Europe *V. lima* Sowerby and *V. digitalina* Lamarck will serve as examples, in the recent fauna *V. abyssicola* Ad. & Rve." Dall, 1890.

The nomenclature of these old and widely distributed groups is extremely involved. *Volutilithes* Swainson, 1831, was commonly accepted for many years, and to it Conrad referred the two characteristic Midway species, *limopsis* and *rugatus*. Dall retained the name *Volutilithes* for species such as those of the *V. petrosa* group in this country and *V. spinosa* Lamarck in Europe. He erected the subgenus *Volutocorbis* to include *Volutilithes limopsis*, a few species from the European faunas, and the Recent *V. abyssicola* Adams and Reeve. Harris in his Midway monograph used only the generic name *Volutilithes*, but Cossmann recognized *Volutocorbis* (*Essais paléoconchologie comp.*, vol. 3, p. 138, 1899) and raised it to generic rank.

*Volutocorbis* sp.

Imperfectly preserved volutes of the form and measurements of *V. limopsis* (Conrad) (Plate 20, figure 1) are fairly common in the downstream section of tilted shales of probable upper Midway age



on the Rio San Juan at U.S.G.S. sta. 13462 (E. 18). The sculpture seems more subdued than that of *V. limopsis*, and no specific determination can be made. Both in the eastern and western Gulf provinces, the true *Volutocorbis limopsis* is apparently the hall mark of the upper Midway. *Volutocorbis texana* Gardner (Plate 16, figures 2, 3) characterizes the upper part of the Kincaid formation but is present also, though rare, in the lower part of the Wills Point formation. The figured holotype is from the Colorado River, 1½ miles below the Travis-Bastrop County line, Bastrop County, Texas. The Mexican shells more closely resemble *Volutocorbis limopsis* from the Wills Point than they do the slightly older *V. texana*, which differs from *V. limopsis* in the less numerous and less commonly spinose axials.

A probable topotype of *Volutocorbis limopsis* (U. S. Nat. Mus. 559305) and the holotype of *Volutocorbis texana* (U. S. Nat. Mus. 370998) are figured.

*Volutocorbis* sp. cf. *V. olssoni* Plummer

(Plate 22, figure 12)

Description of *Volutocorbis olssoni* Plummer:

1933. *Volutocorbis olssoni* Plummer, Univ. Texas Bull. 3232, p. 813, pl. 9, fig. 11.

"Apical angle, 60°. Altitude, 12.5 millimeters. Maximum diameter, 6 millimeters. Number longitudinal ribs, next to last whorl, 35. Number transverse ribs, last whorl, 5. Transverse ribs about equal in height to longitudinal ribs. First 3 smooth, 4th and 5th ribbed, others cancellate.

"Type locality: 'Bank of Solomon's Creek about 5½ miles south-southwest of Elgin, Seguin formation.'" Plummer, 1933.

A single specimen (U. S. Nat. Mus. 497148) of a compact little species was recovered from fossiliferous concretions, probably of Carrizo age, at U.S.G.S. sta. 13682 (F-8). The protoconch has been lost, and only 3 to 4 whorls of the conch remain. These are reticulately sculptured. On the flattened area corresponding to the shoulder of the whorl, the spirals are obscure or wanting except for 2 lirae, directly in front of the suture. The height of the Mexican shell is 13.5 millimeters, the greatest diameter, 7.5 millimeters. Judging from the brief description and the illustration it has much in common with *V. olssoni* Plummer.

*Volutocorbis?* sp. cf. *V.? wheelockensis* (Cossmann)

(Plate 22, figure 11)

Synonymy and description of *Volutocorbis wheelockensis* (Cossmann) (Plate 23, figure 2):

1890. *Volutilithes precursor* DALL, Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 84, pl. 6, fig. 1. Not *Volutilithes praecursor* Bellardi, 1887.

1899. *Volutilithes Wheelockensis* COSSMANN, Essais paléoconchologie comp., vol. 3, p. 137. Substitute name for preoccupied *precursor*.

1933. *Volutocorbis lisbonensis* (Aldrich) var. *crockettensis* PLUMMER, Univ. Texas Bull. 3232, p. 813, pl. 9, fig. 19.

1937. *Athleta wheelockensis* (Cossmann). PALMER, Bull. Am. Paleontology, vol. 7, no. 32, p. 380, pl. 59, figs. 6, 7, 12.

"Shell subfusiform, six-whorled; nucleus small, spiral sculpture of the usual threads near the canal anteriorly, fading away toward the periphery and appearing again on and behind the shoulder; transverse sculpture of twelve or more rather rounded, not much elevated ribs, which, on the last whorl of the adult, are a little sharper by having a long anterior and a short posterior slope, which gives them a sort of flattened appearance; they pass clear over the shell and are sharpest at the periphery, while in most species of this group in American rocks the ribs are most prominent on the shoulder and become obsolete on the body; suture appressed, the whorl in front a little constricted, with a tendency to small, prickly points at the shoulder; aperture narrow, outer lip simple, thickened at the ribs, but not varicose, strongly lirate within; inner lip with a wash of callus anteriorly and two well-marked, subequal, clear-cut, distant plaits; canal a little constricted, nearly straight, deeply notched, forming a fasciole. Max. lon. of shell 28.0; of aperture 20.0; max. diam. 13.0 mm. A fragment indicates a length of aperture sometimes attained of 34.0 mm., corresponding to a shell 47.6 mm. in length.

"The specimens are of Eocene age, the locality half a mile east from Wheelock, Texas [U.S.G.S. sta. 2048]." Dall, 1890.



The figured holotype and two fragmentary paratypes are U. S. Nat. Mus. 111865.

*Volutocorbis? wheelockensis* includes the relatively large shells with an obtuse axial sculpture and a rather crude and irregular shoulder liration. It may be the analogue in the lower Claiborne of the Western Gulf of *V. lisbonensis* Aldrich in a synchronous horizon of the lower Claiborne of the eastern Gulf. The two species share the same type of axial sculpture, and the threading on the shoulder is similar, but the axials of *V. ?wheelockensis* are more numerous, the constriction at the base of the body less pronounced, and probably the average dimensions are higher. Large molds allied to *V. ?wheelockensis* are fairly common and widespread in the middle part of the Laredo formation of northeastern Mexico, but more than one species may be represented.

The figured Mexican specimen is U. S. Nat. Mus. 497147 from the lower part of the Laredo formation at U.S.G.S. sta. 13971 (I-20). Its specific identity is dubious. A similar species, also from the lower Laredo, occurs at U.S.G.S. sta. 13596 (H-15). The large body whorl recovered from the upper Laredo at U.S.G.S. sta. 13771 (H-3), retains no characters by which it may be separated from the paratype and topotypes. Less slender forms, more closely costate and with less sloping shoulders, occur in the lower Laredo at U.S.G.S. sta. 13968 (I-19); in the middle Laredo at U.S.G.S. sta. 13981 (H-6) and U.S.G.S. sta. 13557 (H-10); and in the Yegua formation at U.S.G.S. sta. 13751 (K-6).

#### Genus *Volutospina* Bullen-Newton

1906. *Volutospina* BULLEN-NEWTON, Malacol. Soc. London, Proc., vol. 7, pt. 2, p. 103.  
= *Volutilithes* SWAINSON, Treatise on malacology, p. 318, 1840. Not SWAINSON, 1831.

TYPE, BY ORIGINAL DESIGNATION: *Conus spinosus* Linnaeus. Eocene of the Paris Basin.

Those interested in the extended discussions which have centered about the volutes may be referred to Dall (Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, pp. 74-76, 1890; Smithsonian Misc. Coll., vol. 48, pt. 3, no. 1663, pp. 353-354, 1907), Bullen-Newton (Malacol. Soc. London, Proc., vol. 7, pt. 2, pp. 103-104, 1906), and Stewart (Acad. Nat. Sci. Philadelphia, Proc., vol. 78, pp. 407-408, 1927).

Within the area under consideration, *Volutospina* includes forms closely related to *Volutocorbis* and possibly evolved from them but larger on the whole and coarser, with a spiral sculpture usually absent or very feeble on the medial portion of the shell and an axial sculpture commonly spinose on the periphery. The greater number of the Claiborne species of the Gulf Province are included under the group of *Volutospina petrosa* (Conrad) and descended, according to Burnett Smith (Acad. Nat. Sci. Philadelphia, Proc., vol. 58, p. 57, 1906), from the upper Midway species, *Volutocorbis limopsis* (Conrad). The maximum development of the group was reached during the Claiborne, and forms as diverse in general aspect as *Volutocorbis? haleanus* (Whitfield) (Plate 22, figures 1, 5) and the strongly spinose *V. petrosa* (Plate 16, figure 18) have been referred to a common stock.

#### *Volutospina clayi* (Burnett Smith)

(Plate 22, figure ?14)

1907. *Athleta clayi* BURNETT SMITH, Acad. Nat. Sci. Philadelphia, Proc., pp. 234-242, text figs. 1, 2, 4, 7.  
1937. *Athleta clayi* Smith. PALMER, Bull. Am. Paleontology, vol. 7, no. 32, p. 378, pl. 61, figs. 2-4.

"Locality.—St. Maurice, Louisiana.

"Horizon.—Lower Claiborne.

"The more important morphological features of this species may be summed up as follows:

"Whorl 1.—Smooth and rounded.

"Whorl 2.—Smooth and rounded at first, but soon a very few untubercled but nearly straight ribs appear. These probably represent a somewhat suppressed and condensed curved rib stage. They are followed by the straight tubercled ribs of the cancellated stage. At first the suture tubercle is the larger, but a shoulder angle soon forms and the shoulder tubercle becomes dominant.

"Whorls 3, 4.—Characterized by the cancellated stage. . . .

"Whorls 5, 6.—Characterized by the cancellated stage, but toward the end of 6 the ribbing above the shoulder is gone and the suture tubercles are weak. The shoulder tubercle strengthens and the ribbing below it is well developed. Whorls covered with fine spirals from the shoulder downward.

"Whorl 7.—Still characterized by the cancellated stage. The suture tubercle and the spirals immediately below the shoulder both disappear. The spirals are well developed, however, on the



branchial siphon. Toward the end of the whorl the ribbing below the shoulder disappears and the shoulder tubercles become spine-like, so that the cancellated stage ends with the close of whorl 7.

"Whorl 8.—Characterized by the spiny stage. Shoulder spines sharp. Spirals on the branchial siphon only. Shelly smoothing of the preceding whorl is slight.

"Remarks.—This form is distinguished from the St. Maurice race of *Athleta petrosa* by its large and swollen apex; by its smooth stage which occupies little more than one whorl; by its more or less suppressed curved rib stage, and by the earlier decline of the spirals immediately below the shoulder. . . .

"*Athleta clayi* is almost identical with the examples of *A. petrosa* main stock in everything except its smooth stage. . . .

"It appears that in the normal races of *Athleta petrosa* and its normal allies marked modifications of the later shell stages are preceded by marked modifications in the apex. In addition we can say for this restricted normal group at least that the apex is not only a variable feature, but the most variable feature which the shells furnish." Burnett Smith, 1907.

TYPE MATERIAL: An adult and an adolescent individual from St. Maurice, La. Acad. Nat. Sci. Philadelphia 6760.

Topotypes of *Volutospina clayi* resemble superficially *V. impressa* (Conrad) (Plate 23, figures 1, 3), 1865, described from "Texas", possibly from Robertson and Lee counties, which furnished the material discussed and described by Gabb 5 years earlier.

There is some doubt about the determination of the figured specimen (U. S. Nat. Mus. 497150) from U.S.G.S. sta. 13967 (J-20), but it seems to be an immature individual which is still in the "cancellated" stage of development characterized by a prevalent spiral sculpture. The height of the figured shell is 25 millimeters, the greatest diameter, 14 millimeters. Similar forms occur at U.S.G.S. stas. 13600 (H-15) and 13625 (J-20).

*Volutospina indenta* (Conrad) (Plate 23, figures 8, 9), a relatively slender shell with a high spire, obtuse rather distant ribs, strong lirae on the base of the whorl, and feebly incised grooves on the medial portion of the body, is separable from adult *V. clayi* by the more persistent spiral sculpture, the greater uniformity of the axial sculpture, and the more slender outline. Both *V. indenta* and *V. clayi* are doubtless members of the group of *Volutospina petrosa* (Conrad). In Mexico, *Volutospina clayi* is restricted in its known distribution to the lower part of the Laredo formation.

DISTRIBUTION: Laredo formation: lower Laredo, ?U.S.G.S. sta. 13559 (H-12); ?U.S.G.S. sta. 13454 (H-15); ?U.S.G.S. sta. 13600 (H-15); U.S.G.S. sta. 13596 (H-15); ?U.S.G.S. sta. 13595 (H-15); U.S.G.S. sta. 13602 (H-16); U.S.G.S. sta. 13617 (H-18); ?U.S.G.S. sta. 13968 (I-19); ?U.S.G.S. sta. 13967 (J-20); ?U.S.G.S. sta. 13625 (J-20).

### *Volutospina lapparoides* Gardner, n. sp.

(Plate 22, figures 2-4, 7, 9, 10)

Shell of only moderate dimensions for the genus, compact, conspicuously biconic, the shoulder angle at the aperture a little closer to the apex than to the anterior extremity. Protoconch smooth, coiled three times, the initial turn minute and, for the most part, immersed; second volution increasingly higher and more inflated at the beginning, flattened near the close of the whorl; final protoconchal volution also flattened laterally, shorter than the whorl behind it and with no increase in diameter; break between conch and protoconch ragged. Axial sculpture initiated with the conch; ribs numerous, about 20 to each of the earlier whorls, obtuse, equisized, and equispaced; reduced on the last whorl of the spire and the body of the adult to 8 to 11 peripheral spines. Incremental sculpture relatively strong. Adult spiral sculpture restricted to a few vague striations on the shoulder, but a fairly strong linear channeling upon the body of the juveniles. Suture obscure because of the close winding and the banking of a thin callus against the preceding whorl. Body produced, only slightly constricted in the adult, adorned only with the low peripheral spines and a fairly strong liration on the base of the body and the pillar. Aperture very narrow, oblique to the axis of the shell. Outer lip lirate within. Three strong subequal oblique folds midway between the posterior commissure and the anterior extremity of the aperture. Anterior fasciole little or not at all swollen.

DIMENSIONS OF SLIGHTLY IMPERFECT HOLOTYPE: Height, 30 millimeters; greatest diameter, 14 millimeters; height of imperfect paratype, 22.5 millimeters; greatest diameter, 13 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497140; paratype, U. S. Nat. Mus. 497141.

IMMATURE SPECIMENS: U. S. Nat. Mus. 497143, 497145 and 497146.

HOLOTYPE LOCALITY: U.S.G.S. sta. 13567 (H-11); paratype locality, U.S.G.S. sta. 13565 (H-12).



Locality from which immature figured specimens were collected: U. S. Nat. Mus. 497145, U.S.G.S. sta. 13861 (H-4); and U. S. Nat. Mus. 497143 and 497146, U.S.G.S. sta. 13643 (M-25). Middle part of the Laredo formation.

The biconic outline due to the steep and even slope of the relative high spire and the smoothly drawn out body give to the shell the aspect of *Lapparia*. It differs from *Lapparia*, however, in the smaller nucleus, more produced body, fewer pillar plications, and absence of any pronounced swelling on the anterior fasciole. In the nuclear characters, and in the sculpture pattern of the early whorls, *V. lapparoides* recalls *Volutospina petrosa* (Plate 16, figure 18) and is probably an offshoot from that group. The species is prolific locally in the middle Laredo formation and diagnostic of that horizon. The numerous individuals from U.S.G.S. sta. 13643 (M-25) apparently reach senility earlier than those from Zacate, Nuevo León. The earlier growth stages seem to be identical. The earlier assumption of senility may be due to some local condition or to the possibly younger age of the Santa Ana fauna.

DISTRIBUTION: Laredo formation, middle Laredo: U.S.G.S. sta. 13985 (G-2); U.S.G.S. sta. 13861 (H-4); U.S.G.S. sta. 13984 (H-6); U.S.G.S. sta. 13981 (H-6); U.S.G.S. sta. 13800 (H-9); U.S.G.S. sta. 13685 (H-9); U.S.G.S. sta. 13557 (H-10); U.S.G.S. sta. 13567 (H-11); U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. 13566 (H-12); U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13590 (I-13); U.S.G.S. sta. 13555 (H-14); U.S.G.S. sta. 13556 (I-14); U.S.G.S. sta. 13643 (M-25).

*Volutospina symmetrica* (Conrad)

(Plate 22, figure 8; Plate 23, figures 7, 10)

1854. *Volutilithes symmetrica* CONRAD, in WAILES, Rept. agriculture and geology of Mississippi, p. 289 (name only), pl. 15, fig. 6.  
 1855. *Volutilithes symmetrica* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., 1st ser., vol. 7, p. 260.  
 1865. *Volutilithes symmetrica* CONRAD, Am. Jour. Conchology, vol. 1, p. 24.

"Subfusiform; with longitudinal acute ribs terminating above in short spines on the body whorl; volutions excavated above, where they are striated but not ribbed; body whorl with raised alternated revolving distinct lines; above the angle they become almost microscopic; suture margined below by a series of small points, and somewhat carinated; plaits three, slender.

"Allied to *V. Sayana*, Con." Conrad, 1855.

TYPE LOCALITY: "Green-sand Marl-bed of Jackson, Mississippi."

HOLOTYPE: Coll. Acad. Nat. Sci. Philadelphia 13207.

The protoconch of the holotype includes about  $2\frac{1}{2}$  turns, the conch about 6; the later whorls are straight-sided with a broad scooped-out shoulder. The axials are narrow, acute, ill-defined behind the periphery but uniformly elevated from the shoulder to the anterior suture and well down toward the base of the body. The spiral sculpture of sharply raised lirae is highly characteristic; the lirae are regular and alternating in size on the sides of the body, but no intercalaries are introduced on the spire and the canal. The finely sculptured shoulder band is cut off from the posterior suture by a narrow, nonlirate tabulated area and from the periphery by a slightly wider area. The swelling of the anterior fasciole is perceptible but not conspicuous. The inner margin of the outer lip is lirate.

Dall and others have included *symmetrica* in the synonymy of *petrosa* Conrad (Plate 16, figure 18). The shells of Jackson age in northeastern Mexico are consistently rather small, and the spiral sculpture is well developed over the entire shell. They differ from topotypes of *petrosa* in the less slender outline, the shorter broader anterior canal, the narrow tabulation of the whorl in front of the suture, the prevalent spiral sculpture, and the more numerous but less prominent spinose axials. All these variations can be matched in topotypes of *symmetrica*. Two fairly well preserved individuals differing in the higher dimensions and more slender outline but spirally striated and narrowly tabulate in front of the suture occur in the higher Jackson at U.S.G.S. sta. 13598 (L-11), at Presa El Mescal, Zacate, Nuevo León.

The figured specimen (U. S. Nat. Mus. 497144) is 27.0 millimeters high and 14 millimeters in diameter. It comes from the lower or middle Jackson at U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7° 30' E. of Ciudad Camargo, Tamaulipas.



Subgenus *Eoathleta* Gardner, n. subgen.

Dec. 1853. *Athleta* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., 1st ser., vol. 6, p. 449 (part).

TYPE, HEREWITH DESIGNATED: *Athleta tuomeyi* Conrad. Wilcox of the Gulf Province.

*Athleta* was described and proposed as a genus by Conrad in December 1853. He selected no type, and three species were included: *Voluta rarispina* Lamarck from the Miocene of Dax, south of Bordeaux; *Voluta affinis* Brongniart = *Voluta coronata* Brocchi, according to Sacco, 1890, from the lower Miocene of the Piedmont Basin of Italy; and the new species, *Athleta tuomeyi* Conrad, described from Bashia Creek, Clarke County, Alabama, the type locality of the Bashi formation of the Wilcox group.

Dall in 1890 (Wagner Free Inst. Sci., Trans., vol. 3, pt. 1, p. 75) designated *Voluta rarispina* Lamarck from the Burdigalian of Aquitaine as the type of *Athleta*. The topotypes of the French species exhibit, as Dall remarked, "a normal, *Cassis*-like expansion around the aperture of what, without it, is a typical *Volutilithes*." In the *V. rarispina* group, which was characteristic of the Miocene of southern Europe and did not survive it, the outer lip is thickened and lirate within, and the inner lip is very much thickened and reverted over the body in the manner of the cassids. The outer margin of the callus is sharp and stands apart from the body. The spire is visible and free from wash. In *Athleta tuomeyi*, on the contrary, the outer lip is thin and sharp, but on the posterior half of the apertural surface of the body the callus swirling backward forms a grotesquely thick pad which, in the adults, conceals the entire spire or leaves visible only the subacute apex. The anterior portion of the inner lip is glazed but not padded and retains a normal aspect. There are usually 2 oblique, subequal, subparallel folds, though the number and relative strength of the plaits is not constant. The topotypes of *Voluta rarispina* show 3 subequal folds at a relatively high angle to the axis, and minor plications posterior to the major folds are more constantly developed in the Miocene group than in the Eocene.

*Volutospina (Eoathleta) corvocada* Gardner, n. sp.

(Plate 12, figures 2, 9; Plate 27, figure 10)

Shell dwarfish, crude, and irregular, including about 7 whorls in all. Shell substance thick, recrystallized in all observed specimens. Protoconch small, the initial turn largely immersed, the two succeeding volutions broadly rounded and increasing in diameter with a fair degree of rapidity. No sharp definition between conch and protoconch. Early whorls of conch trapezoidal, rapidly increasing in diameter. Axials about 15 to the whorl on the spire, restricted in their strongest development to the anterior portion of the whorl, largely obscured and distorted in the adult by the overgrowth of callus; posterior portion of the whorls of the spire compressed and thickened a little directly in front of the impressed suture. Body relatively very large, conspicuously shouldered; about 10 axials, spinose at the periphery but evanescent behind it and feeble or evanescent in front of it. Aperture about two thirds the length of the shell, imperfect in all observed specimens. Callus of inner lip very heavy, covering the body wall with a wash sufficiently thick in the adult to conceal the axial sculpture, produced backward and in some individuals almost entirely enveloping the spire. Five columellar folds placed well forward; low, evenly spaced, oblique, the anterior the most feeble; strength and persistence of folds within aperture concealed by indurated matrix. Anterior canal relatively broad and warped.

DIMENSIONS OF HOLOTYPE: Height, 19 millimeters; greatest diameter, 11.5 millimeters.

TYPE MATERIAL: Holotype, U. S. Nat. Mus. 494997; two paratypes, U. S. Nat. Mus. 494998; one paratype, U. S. Nat. Mus. 494999.

TYPE LOCALITY: Holotype, U. S. Nat. Mus. 494997, U.S.G.S. sta. 13473 (B-6), 5.5 kilometers south-southeast of Agualeguas, Nuevo León. Paratypes, U. S. Nat. Mus. 494998, U.S.G.S. sta. 13459 (B-6), 5.5 kilometers south-southeast of Agualeguas, near Loma Comales, Nuevo León; and U. S. Nat. Mus. 494999, U.S.G.S. sta. 13492 (D-18), 4 kilometers northeast of Rancho La Alameda, Coyote Concession, China, Nuevo León.

*Volutospina corvocada* suggests a Liliputian *Volutospina tuomeyi*. The shells certainly look pathologic, but in that case the condition was general, for no normal adults are associated with those in



which the overwash of callus is so remarkably developed. Furthermore, the same condition must have prevailed in the Cerralvo area and in the Rio San Juan section.

DISTRIBUTION: Midway formation: lower Midway, U.S.G.S. sta. 13459 (B-6); U.S.G.S. sta. 13473 (B-6); undifferentiated Midway, U.S.G.S. sta. 13490 (D-18); U.S.G.S. sta. 13492 (D-18).

*Volutospina (Eoathleta) tuomeyi* (Conrad)

(Plate 12, figures 10-12; Plate 22, figure 6)

- 1853. *Athleta tuomeyi* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., 1st ser., vol. 6, p. 449.
- 1865. *Volutilithes (Atheleta) tuomeyi* CONRAD, Am. Jour. Conchology, vol. 1, p. 24.
- 1869. *Volutilithes tuomeyi* CONRAD, Am. Jour. Conchology, vol. 4, p. 248.
- 1880. *Voluta tuomeyi* (Conrad). MELL, Am. Inst. Min. Metall. Eng., Trans., vol. 8, p. 313.
- 1885. *Athleta tuomeyi* Conrad. ALDRICH, Am. Jour. Sci., ser. 3, vol. 30, p. 304.
- 1894. *Volutilithes petrosa* var. *tuomeyi* Conrad. HARRIS, Am. Jour. Sci., 3d ser., vol. 47, p. 303.
- 1896. *Volutilithes (Athleta) tuomeyi* Conrad. CLARK, U. S. Geol. Survey, Bull. 141, pp. 44, 57, 65, pl. 10, figs. 1a, 1b.
- 1906. *Volutilithes petrosus* var. *tuomeyi* Conrad. VEATCH, U. S. Geol. Survey, Prof. Paper 46, pl. 18, fig. 3.
- 1907. *Athleta petrosa tuomeyi* Conrad. SMITH, BURNETT, Acad. Nat. Sci. Philadelphia, Proc. for 1907, pp. 229, 230, 231.
- 1926. *Plejona tuomeyi* (Conrad). COOKE, Geol. Survey Ala., Special Rept. No. 14, p. 268, pl. 94, fig. 4.

"Ovato-turbinate, with revolving lines distinct on the lower half and obsolete above on the body whorl; shoulder with distant prominent acute spines; between the spines and suture the side is flattened, swelling a little near the suture, and has a few revolving raised unequal lines; penultimate whorl concealed by the callous, above which the whorls are finely tuberculated and somewhat turritid; columella with 2 prominent plaits and 3 obsolete ones. Length  $1\frac{1}{4}$  inch.

"Locality. Bashia creek, Clarke Co., Alab." Conrad, 1853.

The incomplete figured adult, U. S. Nat. Mus. 495002, is 43 millimeters high and 30 millimeters broad. It was collected from the Indio formation at U.S.G.S. sta. 13707 (E-12), at the west base of a small hill just north of La Laja, Los Herreras, Nuevo León. The juvenile, U. S. Nat. Mus. 497142, also of Indio age, is from U.S.G.S. sta. 13711 (E-4).

The typical adult *Volutospina (Eoathleta) tuomeyi* is unmistakable. Such specimens, all of them associated with *Venericardia diga* Gardner and Bowles, occur in considerable abundance at U.S.G.S. stas. 13707 (E-12), 13484 (E-12), 13755 (E-15), and 13756 (E-15). Commonly, only the apical portion of the shell and the heavy pad on the inner wall of the aperture remain, but these are adequate evidence of the species. Within the area, however, in which *Volutospina tuomeyi* might not be out of place, there are a number of young and adolescent forms which may represent that species. In that case, it is difficult to understand why in fairly extensive collections the adults so much better adapted for preservation are not found. Such immature forms are present at U.S.G.S. stas. 13461 (D-4), 13669 (E-12), 13675 (E-9), and 13671 (E-10). The young of *V. tuomeyi* have much the aspect of *Volutocorbis*. The spiral sculpture is fairly strong and regular and overrides the axials, the intersections are more or less nodose, and the general aspect of the shell is not far removed from that of *Volutocorbis texana*, of the Kincaid fauna of Texas. It is impossible to use for stratigraphic purposes the juvenile volute material of northeastern Mexico. One or more undescribed species may be represented in the lower Wilcox, but the juvenile (Plate 22, figure 6) is identical with young *V. tuomeyi* from Woods Bluff, Ala.

DISTRIBUTION: Indio formation: lower Indio, ?U.S.G.S. sta. 13461 (D-4); ?U.S.G.S. sta. 13669 (E-12); U.S.G.S. sta. 13707 (E-12); ?U.S.G.S. sta. 13667 (E-12); U.S.G.S. sta. 13484 (E-12); U.S.G.S. sta. 13755 (E-15); U.S.G.S. sta. 13756 (E-15); middle Indio, U.S.G.S. sta. 13711 (E-4); ?U.S.G.S. sta. 13675 (E-9); ?U.S.G.S. sta. 13671 (E-10).

Genus *Caricella* Conrad

- 1835. *Caricella* CONRAD, Fossil shells of the Tertiary formations of North America, vol. 1, no. 3 (republication), p. 44.
- 1846. *Caricella* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., vol. 3, p. 21.

TYPE, BY SUBSEQUENT DESIGNATION: Cossmann, 1899, Essais paléoconchologie comp., pt. 3, p. 129): *Turbinella piruloides* [*pyruloides*] Conrad. Eocene of Claiborne, Ala.



Shell thin, of moderate dimensions, pyriform to slender fusiform. Nucleus, if perfect, bearing an elevated spur. Surface smooth, spirally or reticulately sculptured. Pillar plicate, more than 3 folds, well up on the pillar, oblique, commonly approaching the horizontal; the anterior plication the least prominent. Canal broad, usually rather wide, not emarginate at the extremity.

The genus is apparently restricted in its distribution to the Eocene and Oligocene of North America. Cossmann refers a Senonian form to *Caricella*, the *Melo pyruloides* Forbes from the Arriallor beds of India, but he is in error.

*Caricella?* sp.

A rather large individual, with the apex missing and so firmly embedded in the matrix that the characters of the aperture are completely concealed, is probably referable to *Caricella*, and possibly to *Caricella subangulata* Conrad, 1855, described from Jackson, Mississippi. It is a relatively large specimen with a low spire, inflated body, and a surface free from sculpture other than growth lines. It has been recognized at a single locality in the lower or middle Jackson, U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7° 30' E. of Ciudad Camargo, Tamaulipas.

Superfamily? TOXOGLOSSA

Family CANCELLARIIDAE

Genus *Cancellaria* Lamarck

1799. *Cancellaria*, LAMARCK, Prodrome d'une nouvelle classification des coquilles, Soc. hist. nat. Paris, Mém., p. 71.

TYPE, BY MONOTYPY: *Voluta reticulata* Linnaeus. Recent off the coast of Florida and the West Indies.

Shell of moderate dimensions, usually rather heavy and stout, ovate-conic, or rarely fusoid or oliviform. Spire usually low, commonly scalar. Protoconch smooth, naticoid, generally thrice-coiled. Whorls of conch rarely exceeding 6, generally only 3 or 4. Sculpture normally cancellate; the axial sculpture rarely obsolete, the axials usually narrow and inclined to be irregular in size and spacing, the spirals commonly low and flattened on their summits. Sutures impressed. Aperture obliquely lenticular or auriculate. Outer lip thickened, lirate within. Parietal wall more or less thickly glazed. Columella heavily plicate, the 2 or 3 folds about midway between the extremities of the aperture; the posterior, as a rule, the most prominent and the most nearly horizontal, that in front of it less elevated and more oblique. Margin of pillar usually raised into a relatively feeble plication, which may persist within the aperture or may be restricted to the apertural face of the pillar. Anterior canal typically narrow, short, twisted, nasute. Umbilicus perforate or imperforate, generally with a narrow chink between the reverted labium and the arched anterior fasciole, which functions as an umbilical keel.

The records of *Cancellaria* in the Upper Cretaceous have been questioned, but the genus is well differentiated early in the Tertiary. Recent species probably number between 150 and 200. Most of them are denizens of the inshore waters of the warm temperate and tropical seas.

*Cancellaria?* sp.

(Plate 19, figure 10)

A strongly sculptured form that has lost the diagnostic characters of the aperture was recovered from the calcareous sandstones of the lower marine Oligocene not far from El Amole, Nuevo León. The anterior extremity has been lost in both examples. The protoconch is small and acutely tapering and includes probably 3 whorls, the first 2 smooth, the final turn axially ribbed. The shell exclusive of the canal is somewhat nassoid in outline, and there are 5 conchal whorls. The axial ribs are strong, rounded, undulatory, feebly retractive, tending to die out directly in front of the posterior suture but increasing slightly in elevation toward the anterior suture, persistent to the base of the body, overridden by the spirals. The strong, sharp primary spirals number 3 to each whorl of the spire, 8 on the body; fine secondary threadlets are intercalated on the spire and the medial portion of the body. The aperture is moderately wide and angulated posteriorly. The outer lip is arcuate, the inner convex. Pillar biplicate; possibly additional folds in perfect specimens. No other characters of the aperture have been preserved.



DIMENSIONS OF IMPERFECT FIGURED SPECIMEN: Height, 9.0 millimeters; diameter, 4.9 millimeters.

FIGURED SPECIMEN: U. S. Nat. Mus. 497260.

LOCALITY OF FIGURED SPECIMEN: U.S.G.S. sta. 13518 (N-10). Lower marine Oligocene sandstone.

No closely comparable form has been observed, and without more knowledge of the characters of the aperture the reference of the specimens to *Cancellaria* is uncertain.

#### Subgenus *Trigonostoma* Blainville

1825. *Trigonostoma* BLAINVILLE, Manuel de malacologie et de conchyliologie, p. 652.

TYPE, BY MONOTYPY: *Delphinula trigonostoma* Lamarck. Recent in the Indo-Pacific.

The subgenus is characterized by the rapidly enlarging, angulated whorls, the trigonal aperture, the absence of an anterior canal, and the wide umbilical funnel.

#### *Cancellaria* (*Trigonostoma*) sp.

Juvenile *Cancellaria* referable to *Trigonostoma* have been recovered from a few localities in the Laredo formation of northeastern Mexico. A ribbed species from the middle Laredo at U.S.G.S. sta. 13593 (I-13), General Bravo, Carlos Cantú, Nuevo León, closely recalls *C. panones* Harris, 1895, described from Smithville, Bastrop County, Texas, but the Mexican form is from a higher horizon. In another species from the middle Laredo at U.S.G.S. sta. 13861 (H-4) the periphery of the body is strongly crenate but not axially ribbed and may be similar to one of the forms listed as *Cancellaria babylonica* Lea var. by Renick and Stenzel, 1931.

#### Family TURRIDAE

#### Genus *Michela* Gardner, n. gen.

*Levifusus* of authors, part. Not *Levifusus* Conrad, 1865.

TYPE, BY ORIGINAL DESIGNATION: *Levifusus trabeatoides* Harris. Lower Claiborne of the Western Gulf Province.

Shell of moderate dimensions and thickness, biconic. Protoconch of 3 smooth and 2 sculptured whorls, increasing rapidly in diameter from the minute and, for the most part submerged, initial turn; spiral sculpture introduced at the beginning of the fourth whorl; the posterior spiral outlining the shoulder, the anterior, midway between the posterior spiral and the suture, a third commonly introduced directly behind the anterior suture before the end of the third whorl, all three of the spirals very thin and rasping. Axial sculpture in the form of shoulder puckers initiated near the beginning of the final half nuclear turn and reaching the middle spiral before the close of the protoconch. Line between nuclear and postnuclear turns indicated only by a slight break in the sculpture pattern. Spire terraced, the shoulder a steep ramp, the peripheral angle acute and with or without ornamentation; axial sculpture confined in the genotype to the earlier whorls; entire surface of the conch spirally lirate. Siphonal notch broad and shallow, the axis, a little closer to the outer margin of the shoulder than to the suture. Body whorl bicarinate, sharply constricted at the base into a moderately long and broad canal. Outer lip flaring, obtusely angulated at the periphery; strongly and closely wrinkled within, from the commissure to the entrance to the anterior canal. Inner wall of aperture concave; parietal wash rather thin, less so along the pillar. Anterior canal of moderate length, twisted backward slightly and nasute at its extremity. Pillar margin rather sharp, but the pillar not plicate either on the edge or behind it.

The protoconch of *Levifusus* includes 4 smooth whorls less rapidly enlarging than those of the protoconch of *Michela*, succeeded by a little less than a quarter turn sculptured with about 7 narrow axial ribs. The inner margin of the outer lip of *Levifusus* is smooth, and the pillar bears a single obtuse fold at the entrance to the anterior canal. The canal of *Levifusus* is longer than that of *Michela*, not so broad and not warped at its extremity. An excellent example of *Michela* was figured by Harris under the name of *Levifusus trabeatus* Conrad (Acad. Nat. Sci. Philadelphia, Proc., pl. 22, fig. 11, Sept., 1896). The locality cited is Bells Landing, Alabama River, Monroe County, Alabama. We



have no certain examples of the genus in our collections from the lower Eocene of the eastern Gulf, but it is widely distributed in the lower Claiborne of the western Gulf.

*Michela trabeatoides* (Harris), n. comb.

(Plate 24, figure 13)

1895. *Levifusus trabeatoides* HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 69, pl. 6, figs. 12, 12a.  
 1920. *Levifusus trabeatoides* Harris. DUMBLE, Univ. Texas Bull. 1869, pp. 99, 100, 101.  
 1931. *Levifusus trabeatoides* Harris. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 102, 107.

"General form as figured; whorls 8 or 9; 1, 2, 3 smooth and polished, 4 sub-biangular, 5, 6 with one spiral line just below the suture and two or three more near the base of each whorl where they are crossed by sharp, fine, costae, 7 evenly striate spirally showing more or less distinct costae and curving lines of growth; body whorl evenly striate, bicarinate, with faint indications of tubercles on each carina, lines of growth with a retral curve above the upper carina resembling those of *Surcula*; labrum strongly striate within.

"Below the two prominent carinae there is a third faint one. Large old specimens sometimes show on the body whorl one very strong carina above, while the two lower are rudimentary. Fragments have been obtained which would indicate a total length of an entire specimen of at least three inches. . . .

"At Wood's Bluff, Ala., there is a form of *Levifusus* with characters intermediate between *L. trabeatus* and *L. trabeatoides* and it is doubtless the ancestral type of both. This prototype may then be regarded as having produced the true *L. trabeatus* in Alabama, while in Texas the *L. trabeatoides* was developed." Harris, 1895.

The holotype which was in the collection of the Department of Geology of the University of Texas in 1922 is from Moseley's Ferry on the Brazos River in Robertson County, Texas.

The figured tip (U. S. Nat. Mus. 497445) was recovered from the upper bed at Smithville (U.S.G.S. sta. 10387). The horizon is in the Weches member of the Mount Selman formation. The tip of a topotype of *Levifusus trabeatus* Conrad (U. S. Nat. Mus. 129444) from the Gosport sand at Claiborne, Alabama, is figured for comparison (Plate 24, figure 14).

The Mexican material is imperfectly preserved, but even the molds retain the impressions of a lirate inner labral surface.

DISTRIBUTION: Laredo formation: middle Laredo, ?U.S.G.S. sta. 13861 (H-4); U.S.G.S. sta. 13984 (H-6).

Genus *Surculites* Conrad

1865. *Surculites* CONRAD, Am. Jour. Conchology, vol. 1, p. 213.  
 1892. *Surculites* Conrad. WHITFIELD, U. S. Geol. Survey, Mon. 18, p. 217.  
 1927. *Surculites* Conrad. STEWART, Acad. Nat. Sci. Philadelphia, Proc., vol. 78, p. 420.

TYPE, BY MONOTYPY: *Surculites annosus* Conrad. Eocene (Shark River marl) of New Jersey.

Conrad did not characterize his genus but merely assigned to it the single species, *S. annosus*, which he described and figured badly. In his monograph, Whitfield (1892) published a much better figure of the same specimen and made the following observations:

"The type specimen used by Mr. Conrad in his description and figured on Plate 20, Fig. 9, of the volume cited above [Am. Jour. Conchology], is now in my hands, together with several other specimens of the same, and another much more slender species. They differ but little generically from *Surcula* proper as typified by *S. nodifera* Lam., except in the notch in the lip, and straighter anterior beak, which, from the evidence afforded by the specimens before me, does not seem to be bent or twisted to any extent. . . . The upper surface of the volutions is nearly rectangular and the sinus scarcely marked; in fact, in most specimens the lines of growth indicating it are nearly direct, but below the angle the line is directed forward in a broad curved extension, occupying nearly the entire length of the aperture." Whitfield, 1892.

Stewart in 1927 referred to *Surculites* two species from the Tejon of California and noted the similarity of one of them to *Surculites errans* (Solander) from the upper Eocene of Barton, England.

The most obvious diagnostics of the genus are the angular whorls, strongly carinated at the periphery, the biconic outline, the broad but feeble siphonal notch placed well back toward the posterior suture, and the crowded spirals tessellated by the incrementals.



*Surculites cabezai* Gardner, n. sp.

(Plate 15, figures ?20, ?21; Plate 16, figures 1, 4, 7)

1937. *Surculites engonata* (Heilprin). HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 64, pl. 11, figs. 16-18 (part).

Not *Fusus* (*Hemifusus*?) *engonatus* HEILPRIN, 1880.

Shell fairly large for the family, spindle-shaped, the maximum diameter falling near the median line. Protoconch coiled between three and four times, probably 5 conchal whorls in the fully adult; the line between the nuclear and postnuclear volutions obscure. Initial nuclear turn minute; the first  $3\frac{1}{2}$  volutions smooth, shining, rounded, and increasing rapidly in diameter. Six or 7 faint spirals introduced near the beginning of the fourth volution; equal at their initiation; but the 3 posterior gain in strength less rapidly than the fourth which becomes the peripheral spiral. Earliest whorl of conch broadly rounded medially at least at its beginning but shouldered slightly toward its close; adult whorls strongly angulated, the shoulder sloping gently, the sides slightly convergent, the width of the shoulder greater than the height of the whorl in front of the shoulder. Periphery of the body whorl prominent, the sides in front of the periphery straight or feebly constricted, tapering smoothly at the base into the fairly long but not conspicuously slender canal. Adult sculpture of sharp lirae, tending to alternate in size on the shoulder and sides of the whorl, reticulated with axials of incremental origin but not far from equal to the spirals in strength and in spacing. Shoulder sinus broad, rather shallow, the axis closer to the channeled suture than to the periphery of the whorl. Anterior canal of moderate length and width, obliquely truncate at its extremity.

DIMENSIONS OF HOLOTYPE, AN IMMATURE INDIVIDUAL: Height, 25.8 millimeters; diameter, 12.6 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497417.

TYPE LOCALITY: U. S. Geol. Survey 10386, middle bed at Smithville, Bastrop County, Texas. Cook Mountain formation.

The incomplete Mexican shell (U. S. Nat. Mus. 559286) is from the lower part of the Laredo formation at U.S.G.S. sta. 13563, 2800 meters S.  $55^{\circ}$  E. of Doctor Cos, Nuevo León.

Harris united the lower middle Eocene individuals of the western Gulf region under Heilprin's *S. engonata*, described from Woods Bluff, Alabama, (holotype: Acad. Nat. Sci. Philadelphia 13249). The spiral sculpture of the Wilcox species is finer and closer, and the axial lirae on the sides of the whorls usually are more elevated and slightly coarser. Young forms from a Claiborne horizon on the Brazos River slightly higher than that at Smithville exhibit a still more decided sculpture pattern and probably represent forms sufficiently distinct to be excluded from *S. cabezai*. The Mexican individuals referred tentatively to *S. cabezai* are somewhat distorted and incomplete and may represent a distinct species. They seem to be more closely allied to the Smithville shells than to those from the later horizon on the Brazos River, but the spire is higher, the shoulder not so wide relatively nor so sloping, and the distance between the periphery and the anterior suture correspondingly greater. *S. cabezai* differs from *S. cortezi* of the middle Laredo of Nuevo León in retaining the shoulder sculpture to full maturity.

DISTRIBUTION: Laredo formation: lower Laredo, ?U.S.G.S. sta. 13563 (H-12); ?U.S.G.S. sta. 13602 (H-16); ?U.S.G.S. sta. 13617 (H-18).

*Surculites cortezi* Gardner, n. sp.

(Plate 15, figures 19, 22)

Shell large for the family and the genus; spindle-shaped, the whorls strongly shouldered. Apical portion lost. Three strongly terraced whorls of the conch remaining, the width of the slightly concave shoulder greater than the height of the sides of the whorls. Posterior margin of shoulder closely appressed against the preceding whorl; the anterior margin slightly upturned into the pinched and prominent periphery. Side of the body in front of the periphery feebly constricted; the base of the body evenly contracting into the rather wide and probably not very long canal. Shoulder and sides of earlier whorls threaded with about 5 lirae somewhat irregular in size and spacing, obsolete on the shoulder of the final whorl. Base of the body and the anterior canal lirate; the lirae increase in prominence and in closeness of spacing anteriorly. Posterior fasciolar notch broad and shallow, the axis closer to the posterior than to the anterior margin. Anterior extremity lost.



**DIMENSIONS OF HOLOTYPE:** Height of imperfect specimen: 37.0 millimeters; estimated height of specimen before breakage, 50 millimeters; diameter, 27.5 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 559287.

**TYPE LOCALITY:** U.S.G.S. sta. 13565 (H-12), 4750 meters S. 74° E. of Doctor Cos, Nuevo León, Mexico. Middle part of the Laredo formation.

In both *Surculites cortezi* and *S. engonata exoleta* Harris the shoulder sculpture becomes obsolete; in Harris' type from Smithville the fade-out is evident on a specimen 8 millimeters high; in the Mexican species the young and adolescent whorls exhibit a distinct spiral threading on the shoulder, and only on the final whorl do the lirae disappear. *S. cortezi* has been collected only from the middle Laredo formation, *S. cabezai* only from the lower Laredo.

#### Genus *Orthosurcula* Casey

1904. *Orthosurcula* CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 151.

**TYPE, BY SUBSEQUENT DESIGNATION** (Gardner, Univ. Texas Bull. 3301, p. 215, 1935, not 1933 as on title page): *Pleurotoma longiforma* Aldrich. Vicksburg Oligocene of Mississippi.

"The species are large, moderately stout, completely devoid of ribbing and have the beak elongate, tapering, relatively slender and straight. The spirals are close-set, moderate or small in size, sometimes granulose, and the whorls are more or less broadly inflated below and feebly concave posteriorly. The outer lip projects in the middle as a broad rounded lobe beyond the juxta-sutural part, with the sinus large and posterior, as in *Surcula*, and the embryo is paucispiral." Casey, 1904.

The lower Eocene species still retain a feeble retractive axial sculpture on the earlier whorls of the conch, and though this character is pushed farther back in the Oligocene, in many individuals of the type species it is still manifest as a shallow undulation of the periphery. The protoconch of the type includes 3 to 3½ smooth, polished whorls rapidly increasing in size, and about three fourths of a whorl with sharp, obliquely arcuate costae.

*Orthosurcula* Casey covers a group formerly included under *Surcula*, characterized by a fusoid outline, multispiral protoconch, moderately long anterior canal, and a broad, rather deep siphonal notch set squarely on the shoulder. Some of the species, such as *Orthosurcula pagodiformis* (Heilprin) (Plate 14, figure 4) from the Tuscaloosa, approach rather closely to *Levifusus*, but *Levifusus* is a thinner shell, usually with a more flaring aperture and a pillar which bears a feeble fold. The species described by Aldrich, 1895, under the name of *Pleurotoma langdoni* Aldrich (Plate 25, figures 17, 22) may be a highly sculptured end member of the *Orthosurcula* group which burgeoned in the Gulf Province during the lower Eocene.

#### *Orthosurcula longipera* (Harris)?

Synonymy and description of *Orthosurcula longipera* (Harris):

1896. *Pleurotoma longipera* HARRIS, Bull. Am. Paleontology, vol. 1, no. 4, p. 78, pl. 7, fig. 15.

1935. *Orthosurcula longipera* (Harris). GARDNER, Univ. Texas Bull. 3301, p. 216. (Not 1933 as on title page.)

"General form as indicated by the figure; spire of about seven whorls; 1, 2, and 3 smooth, 4 costate, these are embryonic; remaining spiral whorls with a subsutural band traversed by a revolving line, below with fine lines of growth and alternating spiral lines; carinations of 5 and 6 obliquely and faintly costate.

"This species resembles *P. persa* and *P. gabbi*; from the former it is distinguished by its much more constricted sutures and the subsutural band; from the latter it differs in having more constricted sutures, by having a tendency to costation in the upper spiral whorls, not embryonic.

"**Locality.**—Alabama: Matthews' Landing.

"**Type:** Paleontological Museum, Cornell Univ." Harris, 1896.

Indeterminate fragments referable to *O. longipera* or a related species occur in beds of Midway age at U.S.G.S. stas. 13459 and 13473 (B-6), 5.5 kilometers south-southeast of Agualeguas and at U.S.G.S. sta. 13463 (B-9), at the top of the fucoidal sandstone 7600 meters east of the old church at Cerralvo, Nuevo León. The shells exhibit the slender outline of *Orthosurcula longipera tobar* Gardner from the Kincaid formation of Maverick County, Texas, but the spiral threading on the shoulder is not so strong, and the incrementals tracing the former posterior sinus are stronger. *Orthosurcula?*



*adeona* (Whitfield) (Plate 25, figure 8), a species of similar distribution, is less slender than *O. longipera* with an outline intermediate between Harris' species and *Orthosurcula pagodiformis* (Heilprin).

Genus *Protosurcula* Casey emend. Harris

1904. *Protosurcula* CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 144.

1937. *Protosurcula* HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 48.

TYPE, BY ORIGINAL DESIGNATION: *Surcula gabbii* Conrad. Lower Claiborne of the western Gulf region.

"In this genus and *Eosurcula* there is no trace of ribbing, and the moderately large species composing them may be considered allied more closely to the *Cochlespira* group than any other; the embryo in both is conical or conoidal and multispiral, and, in *Protosurcula* is generally very large and with conspicuous longitudinal riblets on the lower whorls. The collar below the suture is cariniform and the long fasciolar surface between it and the obtuse periphery is broadly concave and with fine spiral lines; below the periphery the spiral lyrae are rather coarse. The columella is straight and generally simple, though sometimes having a strong plica above the middle. The spire tapers evenly to the apex and the beak is slender and frequently very long, the aperture and long straight canal combined being much longer than the remainder of the shell in *gabbii* [gabbii] which is assumed as the type." Casey, 1904.

Casey included three species under *Protosurcula*: the genotype, *Surcula gabbii* Conrad; a closely related species, *Protosurcula tenuirostris* Casey, described from Smithville, Texas; and *Borsonia plenta* (Plate 25, figures 3, 5) Aldrich and Harris, which, like the genotype, is an elevated, slender shell with a long anterior canal but which differs in nuclear characters and in the development of a columellar fold at the base of the body. Harris isolated under *Plentaria* the plicate forms but considered them closely related to *Protosurcula*.

The group is peculiarly characteristic of the lower Claiborne of the western Gulf.

*Protosurcula gabbii* (Conrad) s. l.

(Plate 25, figures 14, 15)

- 1865. *Surcula Gabbii* CONRAD, Am. Jour. Conchology, vol. 1, p. 142, pl. 11, fig. 5.
- 1880. *Pleurotoma platysoma* HEILPRIN, U. S. Nat. Mus., Proc., vol. 3, p. 150, pl. (no number), fig. 3.
- 1891. *Surcula Gabbii* Conrad. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, p. 394.
- 1895. *Pleurotoma (Surcula) gabbi* Conrad. HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 56, pl. 4, fig. 5.
- 1896. *Pleurotoma gabbii* Conrad. VAUGHAN, U. S. Geol. Survey, Bull. 142, p. 38.
- 1897. *Surcula gabbi* Conrad. ALDRICH, Bull. Am. Paleontology, vol. 2, no. 8, p. 5, pl. 4, fig. 2.
- 1904. *Protosurcula gabbi* (Conrad). CASEY, St. Louis Acad. Sci., Trans., vol. 14, p. 145.
- 1920. *Pleurotoma (Surcula) gabbi* (gabbii in 3 of the 10 citations) Conrad. DUMBLE, Univ. Texas Bull. 1869, pp. 88, 91, 92, 95, 96, 97, 98, 99, 100, 106.
- 1931. *Surcula gabbi* Conrad. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 93, 100.
- 1937. *Turricula (Protosurcula, emend) gabbi* (Conrad). HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 48, pl. 9, figs. 26-31.

"Fusiform; volutions eight or nine, convex and subangulated beneath and indented above, with fine revolving lines, the indented space angular above, between which angle and the suture the striae are largest; this indentation has minute, very close-arranged revolving lines; body volution with numerous rugose alternated lines, obsolete on the upper part of the volution; beak long and straight.

"Locality.—Texas." Conrad, 1865.

Conrad's holotype (Acad. Nat. Sci. Philadelphia 13240) possibly came from the Brazos River, but neither the exact locality nor the horizon is known. It is a badly worn shell with the tip lost and the extremity of the anterior canal broken. Renick and Stenzel have indicated in their report on the lower Claiborne on the Brazos River that more than a single species is covered by Conrad's name. Any attempt to break down the *gabbii* group should be made from the Texas rather than from the Mexican material, for the nuclear characters are not preserved in the Mexican individuals, the anterior extremity is lost, and the sculpture pattern somewhat obscured. The figured specimens from the basal part of the Laredo formation near China, Nuevo León, may represent a variation sufficiently distinct to be recognized in the nomenclature. The China forms are less slender than those from the higher horizons of the Laredo, and most of them show a decidedly greater relative diameter than the figured specimen; the fasciolar depression is less sharply defined, the threading both



in front of and behind the suture channel is less regular, and the threads tend to alternate in size. Many of the specimens from Smithville are stouter than those from the higher horizons, but none show as great a relative diameter as some of the shells from Carlos Cantú. The group is prolific, and a detailed study of the variations will afford additional data of value in zoning.

Aldrich noted in 1897 that Heilprin's *P. platysoma* was nothing more than a decorticated *P. gabbii*. The type is U. S. Nat. Mus. 8916.

DIMENSIONS OF IMPERFECT FIGURED SPECIMEN (U. S. Nat. Mus. 497418): Height, 29 millimeters; diameter, 13 millimeters.

LOCALITY: U.S.G.S. sta. 13596, China, Carlos Cantú, Nuevo León. Lower part of the Laredo formation.

DISTRIBUTION OF *Protosurcula gabbii* (Conrad), s. l.: Laredo formation: lower Laredo, U.S.G.S. sta. 13568 (G-11); U.S.G.S. sta. 13596 (H-15); U.S.G.S. sta. 13595 (H-15); U.S.G.S. sta. 13618 (H-17); U.S.G.S. sta. 13617 (H-18); U.S.G.S. sta. 13968 (I-19); U.S.G.S. sta. 13970 (I-19); U.S.G.S. sta. 13971 (I-20); U.S.G.S. sta. 13625 (J-20).

#### Genus *Eosurcula* Casey

1904. *Eosurcula* CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 145.

"The embryo in *Eosurcula* is much narrower than in *Protosurcula*, strongly elevated and smooth throughout, the subsutural collar smaller and less developed, the fasciolar surface thence obliquely ascending but straight in profile or nearly so to the obtusely angulate periphery, on and below which the spirals become coarser. The aperture and canal are nearly as in *Protosurcula*, but the peculiar narrow elevated embryo, perfectly smooth throughout and without riblets, higher shoulder angle and oblique fasciolar surface, less developed subsutural collar and some other differential characters, will readily serve to separate the two genera, which are perhaps the most characteristic and abundant forms of the Lower Claiborne Eocene—and impart a marked difference in habitus." Casey, 1904.

TYPE, HERewith DESIGNATED: *Turris moorei* Gabb. Caldwell County, Texas.

#### *Eosurcula moorei* (Gabb) s. l.

(Plate 25, figure 2; Plate 27, fig. ?17)

Synonymy and description of *Eosurcula moorei* (Gabb):

- 1860. *Turris moorei* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 378, pl. 67, fig. 11 (fig. 9, cited in text by error).
- 1895. *Pleurotoma* (*Surcula*) *moorei* Gabb. HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 57, pl. 4, figs. 6, 6a, 6b.
- 1920. *Pleurotoma* (*Surcula*) *moorei* Gabb. DUMBLE, Univ. Texas Bull. 1869, pp. 91, 95, 100.
- 1931. *Surcula moorei* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 100.
- 1937. *Eosurcula moorei* (Gabb). HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 41, pl. 8, fig. 7 (synonymy excluded).

"Shell elongated fusiform, whorls nine or ten, strongly carinate; mouth narrow, long, half the length of the shell, inner lip covered with a very delicate coat of enamel, so thin as to be visible only on a very well preserved specimen, outer lip thin, showing internally the marks of the larger ribs; surface marked by about twenty-five revolving lines, smaller on the shoulder of the whorls (except one large one at the upper edge below the suture) than elsewhere; in the largest specimens, two or three of the principal ribs are compound, the rest are simple, near the apex; on the upper two of the principal revolving lines are small tubercles which disappear in the succeeding whorls.

"*Dimensions*.—Length 1.1 in., length of mouth .55 in., width of body whorl .3 in.

"The fine specimen figured, is in my collection from Caldwell Co., Texas. It is nearly twice as large as any other specimen I have seen, of the same species." Gabb, 1860.

HOLOTYPE: Acad. Nat. Sci. Philadelphia 13287.

In *Eosurcula moorei*, as in *Protosurcula gabbii*, a group of closely related forms rather than a single species is involved. Renick and Stenzel have already indicated the heterogeneity of the assemblage in their faunal lists from the lower Claiborne of the Brazos River and have discriminated under *moorei* formae 1, 2, and 3. Harris has characterized and figured several varieties, but he has included under the restricted name the species *Pleurotoma tuomeyi* Aldrich, described from Woods Bluff, a valid species which not infrequently exceeds 40.0 millimeters in height and which develops a more pronounced axial hachuring. The early whorls of the conch of the Bashi species are carinated,



and the sides of the whorl in front of the keeled periphery are, as a rule, rippled by axials which, however, become obsolete on about the third or fourth whorl of the conch. A strong spiral outlines the periphery of *E. moorei*, but no axial ribbing is developed in front of it.

All the Mexican specimens are from the lower part of the Laredo formation. Most are heavily corded and resemble in a general way some of the varieties described by Harris, 1937. A single individual from U.S.G.S. sta. 13564 (H-12), near Doctor Cos, Zacate, Nuevo León, can be duplicated in our material from the Brazos River near Stone City. The specimen (U. S. Nat. Mus. 497419) (Plate 25, figure 2) from U.S.G.S. sta. 13967 (J-20), Carlos Cantú, has in common with the species figured by Harris, (Palaeontographica Americana, 1937, pl. 8, fig. 19) under the name of *moorei moorella*, new var., high straight-sided whorls carinated and corded at the periphery and an incremental grating that is exceptionally strong. There are, however, differences in the detail of the pattern of the spirals and possibly other and more important differences that are recorded only in the parts of the shell that have been lost. The Mexican individual is associated with a lower Laredo fauna; Harris' species from "the vicinity of Columbus," on the Louisiana side of the Sabine River, probably came from a higher horizon of the lower Claiborne, possibly from the equivalent of Stenzel's "Stone City beds". Between 3 and 4 whorls are preserved on the Mexican shell. These whorls are high and increase in diameter very slowly. The body is attenuated into a slender but not greatly produced anterior canal. The narrow, sloping, slightly excavated shoulder is outlined by a heavy peripheral cord. Three or 4 fine lirae are evenly spaced on it, and there are 1 or 2 coarser threads close to the posterior suture. In front of the periphery, the 4 or 5 flattened cords, with or without intercalated secondaries, and the incremental grating developed on the interspiral areas give a sculpture pattern recalling that of *Mitra* (*Tiara*). On the fasciole, the growth lines are obscure, and the broad notch, set squarely upon the shoulder, can be only faintly traced. The suture is channeled. The spiral sculpture on the base of the body and the anterior canal is probably rather fine and even. The anterior canal is obliquely truncate at its narrow extremity. A poorly preserved specimen from the lower Laredo in Carlos Cantú (U.S.G.S. sta. 13600), is closely related.

DIMENSIONS OF IMPERFECT FIGURED SPECIMEN (U. S. Nat. Mus. 497419): Height, 25.0 millimeters; diameter, 7.5 millimeters.

LOCALITY: U.S.G.S. sta. 13967 (J-20), lower part of Laredo formation.

The other specimen (U. S. Nat. Mus. 497420, from U.S.G.S. sta. 13971, I-20) has the same general outline and sculpture pattern, but the spirals seem decidedly coarser, and the major spirals show traces of a medial grooving. The peripheral spiral, indeed, may be tripartite. Much of the matrix still adheres to the shell; the character of the growth sculpture is not known, but there are some indications that it is relatively very strong. The reference of this specimen to the *E. moorei* group is a little dubious.

The height of the imperfect figured specimen is 19 millimeters; the diameter, 7.5 millimeters.

Fragments of a possibly similar, though more coarsely sculptured, form were recovered from the lower Laredo, at U.S.G.S. sta. 13601 (H-16); from the vicinity of China, Carlos Cantú, Nuevo León. On these fragments, the incremental sculpture is remarkably strong and overrides the finer spirals.

DISTRIBUTION: Laredo formation: lower Laredo, U.S.G.S. sta. 13564 (H-12); U.S.G.S. sta. 13600 (H-15); U.S.G.S. sta. 13968 (I-19); U.S.G.S. sta. 13970 (I-19); ?U.S.G.S. sta. 13971 (I-20); U.S.G.S. sta. 13967 (J-20).

#### Genus *Leptosurcula* Casey

1904. *Leptosurcula* CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 157.

TYPE, BY ORIGINAL DESIGNATION: *Pleurotoma beadata* Harris. Lower Claiborne Eocene of Texas.

"In this genus the form is very slender, fusiform, the canal very long, the aperture and canal together being about half as long as the entire shell. The embryo is relatively very large, higher than wide, conical and composed of five or six polished whorls, the lower whorls gradually acquiring close-set longitudinal riblets, and then, equally gradually, the spiral lyrae. The type is the very isolated *P. beadata* Harris, of the Texas Eocene, a slender and much elongated species, with a long slender and gradually tapering beak. The series of small rounded close-set nodules, forming the subsutural collar, are completely independent of the relatively large and oblique costae, which are less than half as numerous. The strong even spiral lyrae are also a peculiar feature." Casey, 1904.



*Leptosurcula beadata* (Harris)?

Synonymy and description of *Leptosurcula beadata* (Harris):

1895. *Pleurotoma beadata* HARRIS, Acad. Nat. Sci. Philadelphia, Proc., vol. 47, p. 57, pl. 4, fig. 7.  
 1904. *Pleurotoma beadata* Harris. CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 157.  
 1937. *Leptosurcula beadata* (HARRIS), Palaeontographica Americana, vol. 2, no. 7, p. 80, pl. 13, figs. 30, 31.

"General form as shown in the figure; whorls 9; 1, 2, 3 smooth, 4, 5 transversely costate, 6, 7, 8 obliquely costate, the costae most pronounced not far below the suture and dying out below, evenly and coarsely striate spirally; suture bordered below by a raised crenulated line; body whorl either costate on its humeral portion or plain; evenly striate spirally; retral sinus shallow, canal long, straight.

"*Locality*.—Smithville, Bastrop Co., Tex.

"*Geological horizon*.—Lower Claiborne Eocene.

"*Type*.—Texas State Museum." Harris, 1895.

A single imperfect shell from U.S.G.S. sta. 13596 (H-15) in the lower part of the Laredo formation, exhibits the coarse spiral lirae and oblique axial rippling that characterize *L. beadata* (Harris). The coarser threading on the Mexican individual possibly indicates a subspecific variation. In the Texas series, the species is restricted to the Weches fauna of Bastrop County.

Genus *Hesperiturris* Gardner, n. gen.

TYPE: *Turris nodocarinata* Gabb. Upper part of the lower Claiborne in the western Gulf Province.

Shell rather small or of moderate dimensions, slender, multispiral, the body rather abruptly constricted into the short anterior canal. Protoconch of genotype of 5 to  $5\frac{1}{2}$  volutions, the initial turn minute and largely immersed, the 3 to  $3\frac{1}{2}$  succeeding whorls also smooth and shining, broadly rounded, and increasing rather rapidly in diameter, the final whorl in whole or in part axially costate, the costae feebly arcuate. Sculpture pattern elaborate; entire conch spirally lirate; periphery and sutural collar noded, the peripheral nodes protractive, commonly confined to the peripheral area and obsolete toward the aperture. Posterior fasciole moderately wide, depressed. Sinus broadly U-shaped, moderately deep, the axis running closer to the periphery than to the posterior suture.

This group of mid-Eocene turrids of the Gulf region is characterized by a slender multispiral protoconch and a slender multispiral conch with a short body and a short anterior canal, a spiral sculpture developed over the entire conch, and a nodose axial sculpture developed, as a rule, on the raised cord directly in front of the suture and on the medial portion of the whorl but not persistent over the entire conch. These species have been included in whole or in part under *Strombina* De Gregorio, 1890, *Gemmula* Weinkauff, 1875, *Coronia* De Gregorio, 1890, and *Eopleurotoma* Cossmann, 1896. *Strombina* was a preoccupied name, *Gemmula* is based on a Recent shell from the Pacific with a slitlike fasciole squarely on the keel, and *Coronia* and *Eopleurotoma* differ so greatly in the characters of the protoconch that they cannot be considered congeneric.

The 2 final whorls of the protoconch of the genotype of *Coronia*, *C. childreni* Lea, are axially costate and larger relatively and absolutely than the final whorls of *Hesperiturris*. The last whorl of the protoconch of *C. childreni* is larger than the first whorl of its conch. In *Hesperiturris*, the decrease in the diameter of the nuclear whorls toward the apex is gradual. We have no examples of *Eopleurotoma multicostata* (Deshayes), the genoholotype, but in *E. curvicosta*, the plesio-type of *Eopleurotoma*, the protoconch is paucispiral and includes only about 2 complete volutions, the initial turn inflated, pappilate, and tilted, the final turn also smooth and shining but becoming narrow and flattened toward its close; the axial sculpture is introduced gradually and only with the beginning of the conch. Certainly the *Hesperiturris nodocarinata* group is more closely allied to *Coronia* of the Eocene of the Gulf fauna than to *Eopleurotoma* of the Eocene of the Paris Basin, and possibly the differences that separate it from *Coronia* are overstressed in giving full generic value to *Hesperiturris*.

*Hesperiturris nodocarinata* (Gabb) s. l.

(Plate 24, figures 3, 4; Plate 25, figure 7; Plate 27, figure 13)

1860. *Turris nodocarinata* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 379, pl. 67, fig. 13.



1865. *Surcula nodocarinata* Gabb. CONRAD, Am. Jour. Conchology, vol. 1, p. 19.  
 1866. *Surcula nodo-carinata* (Gabb). CONRAD, Smithsonian Misc. Coll., no. 200, p. 18.  
 1890. *Pleurotoma nodo-carinata* Gabb. DE GREGORIO, Annales géologie paléontologie, vol. 7, p. 24.  
 1891. *Surcula nodo-carinata* Gabb. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, p. 394.  
 1895. *Pleurotoma (Drillia) nodocarinata* Gabb. HARRIS, Acad. Nat. Sci. Philadelphia, Proc. for 1895, p. 59, pl. 5, fig. 4.  
 1904. *Eopleurotoma nodocarinata* (Gabb). CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 127.  
 1931. *Drillia nodocarinata* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 100.  
 1937. *Eopleurotoma nodocarinata* (Gabb). HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 34, pl. 5, figs. 19-22.

"Turritid; whorls seven, strongly carinated below the middle; suture distinct; mouth linear, columella straight; surface marked by a row of beading, directly below the suture, top of the whorl plain, carina marked by another nodose band larger than the first, rest of the whorl marked by about fifteen heavy revolving ribs, growing smaller on the canal and crossed by much smaller longitudinal lines.

"*Locality*.—Wheelock, Texas. Collection of the Academy." Gabb, 1860.

A lectotype, Acad. Nat. Sci. Philadelphia, 13288, is figured.

The figured specimen from northeastern Mexico tapers less rapidly than the average individual from Moseleys Ferry, and the axial ribbing is more oblique. The abundant so-called *nodocarinata* material from both the eastern and western Gulf regions offers a fruitful field for investigation and doubtless includes, as Harris has indicated, a number of closely related species or subspecies. The Mexican individuals, however, are uniformly in an imperfect state of preservation and can be used only as comparative material when the major separations have been worked out from less imperfect forms.

**DIMENSIONS OF IMPERFECT FIGURED SPECIMEN:** Height, 16.5 millimeters; diameter, 6.4 millimeters.

**FIGURED SPECIMEN:** U. S. Nat. Mus. 497424 from U.S.G.S. sta. 13644 (M-25). Middle part of the Laredo formation.

The same variant may be represented by imperfect material also from the middle Laredo, from U.S.G.S. sta. 13984 (H-6), 1940 meters S. 34° E. of La Presa No. 1, Mier, Tamaulipas, although the nodes in the examples from La Presa are less numerous. The figured juvenile (U. S. Nat. Mus. 559393, Plate 27, figure 13) from U.S.G.S. sta. 13643 (M-25), is closely related to the figured adult and, like it, comes from the middle Laredo near Rancho Barretosa in southern Tamaulipas.

Two other variants may be noted: a slender, acutely tapering, closely noded form from the lower Laredo at U.S.G.S. sta. 13600 (H-15), and possibly from 13591 (H-13) in the middle Laredo; and a second, stouter, more obtuse form with a more produced and less abruptly contracted body. This second variant is fairly common, but none of the individuals have retained more than the crudest sculpture detail. Such forms occur in the middle Laredo at U.S.G.S. sta. 13569 (H-12), in General Bravo, Carlos Cantú, Nuevo León, and at U.S.G.S. sta. 13565 (H-12), 4750 meters S. 74° E. of Doctor Cos, Zacate, Nuevo León. Other individuals from this same locality exhibit an oblique axial ribbing less crowded than that in the figured shell (Plate 25, figure 7) and restricted to a very narrow peripheral area. Apparently in the Mexican material the oblique ribbing is more prevalent in *Hesperiturris* from the middle part of the Laredo formation; in the lower horizons the axial sculpture tends to be more nodular.

*Hesperiturris amichel* Gardner, n. sp.

(Plate 25, figures 1, 10, 16)

Shell of moderate dimensions, slender, multispiral with a relatively full body whorl rather abruptly constricted into a short anterior canal. Protoconch and earliest whorls of conch lost; a little less than 5 whorls remaining, the whorls narrow, increasing slowly in diameter, corded in front of the suture, the shoulder gently sloping; whorls constricted slightly in front of the noded periphery, which occupies about half the width of the whorl. Spiral sculpture including the heavy sutural cord, the 6 to 8 rather strong and regular lirae upon the sides and base of the body and the anterior canal, and a very fine striation which may have been developed over the greater part of the shell but which is obscured by the poor preservation. Axial sculpture including a series of peripheral nodes elongated obliquely parallel to the growth lines, 16 or 17 to the whorl, and on the earliest volutions a series of



nodes on the sutural cord, the nodes intermediate in position between the peripheral nodes. Sinus broadly U-shaped and symmetrically disposed on the shoulder between the sutural cord and the periphery. Anterior fasciole rasped by the growth lines, obliquely truncate at the extremity.

**DIMENSIONS OF HOLOTYPE:** Height of imperfect specimen, 20.5 millimeters; estimated height of perfect specimen, 23.5 millimeters; diameter, 9.0 millimeters.

**DIMENSIONS OF PARATYPE:** Height, 16 millimeters; diameter, 6.5 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 497421; paratype, U. S. Nat. Mus. 497422.

**LOCALITY OF HOLOTYPE:** Middle part of the Laredo formation: U.S.G.S. sta. 13567 (H-11); locality of paratype: U.S.G.S. sta. 13569 (H-12).

None of Gabb's illustrations of his mid-Eocene species from Texas are really good, but most of them indicate the characteristic features sufficiently to be identifiable. This is not true of *Turris nodocarinata* Gabb, 1860. The indicated height of his figured specimen, presumably the type, is slightly less than 8 millimeters. The height of the aperture is slightly greater than half the height of the entire shell, and the constriction at the base of the body is very gentle. In the older collections, most specimens included under *nodocarinata* are slender high-spined shells, 15 to 20 millimeters or more high; the bodies are short and abruptly constricted at the base, and the aperture decidedly less than half as high as the entire shell. Both a spiral and axial sculpture are developed in a bewildering range of variation. Harris (Acad. Nat. Sci. Philadelphia, Proc., p. 59, 1895) was unable to identify the figured specimen from among the numerous individuals in Gabb's type material, but it should be possible to select a lectotype and preserve a name so well established. The Mexican individuals are larger and coarser than the species with noded carinae abundant in the mid-Eocene of Texas, and the spirals on the base of the body and the anterior canal are fewer and stronger. There is, however, a considerable variation in the relative width occupied by the peripheral nodes of the Mexican shells. In many of the individuals referred to *H. amichel* the nodes do not extend so far forward as they do on the holotype, and 1 or 2 spiral threads similar to those on the body are visible between the periphery and the anterior suture. These characters are shown to a slight degree upon the paratype (Plate 25, figures 1, 10).

The fragmentary adolescent shown (Plate 25, figure 12), may represent a closely allied species distinguished from *H. amichel* by the narrower more closely noded whorls and the more prominent sutural collar.

**DISTRIBUTION:** Laredo formation: middle Laredo, ?U.S.G.S. sta. 13772 (G-3); U.S.G.S. sta. 13978 (H-5); U.S.G.S. sta. 13567 (H-11); U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13570 (H-12).

*Hesperiturris zacatensis* Gardner, n. sp.

(Plate 24, figures 2, 5)

Shell rather small, slender; apical portion lost; the 3 last whorls of the spire and a complete body remain. Whorls of spire slowly enlarging; the shoulder steeply sloping, slightly concave, the periphery medial or nearly so the sides of the whorls converging slightly, the produced body merging smoothly into the short pillar. Axial sculpture restricted to the peripheral area, nodose on the earlier whorls, the nodes more compressed and obliquely produced on the later and, toward the aperture, irregular or obsolete. Spiral sculpture of flattened bands obscurely noded by the incrementals and separated by narrower, squarely channeled interspaces. Suture following the interspace between the 2 posterior spirals of the series; half a dozen such spirals developed on the side and base of the body and about 8 narrower, less prominent spirals on the pillar and the anterior fasciole. Shoulder sculptured by an obscurely noded sutural spiral and 2 or 3 obscure lirae; retral sinus broadly U-shaped, symmetrically disposed between the posterior suture and the periphery. Aperture very narrow, the outer lip flaring along the vertical axis, the character of the inner surface concealed by the matrix. Pillar apparently smooth. Canal short, not sharply differentiated, blunt at its extremity.

**DIMENSIONS OF IMPERFECT SHELL:** Height, 15 millimeters; diameter, 5.2 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 497427.

**TYPE LOCALITY:** U.S.G.S. sta. 14009 (M-13). Upper part of Jackson formation.

*Hesperiturris zacatensis* is remarkable for the slender outline and the width of the spirals which gird the body. Nothing very close to it has been recognized, nor is it known excepting at the type locality.



Genus *Coronia* De Gregorio

1890. *Coronia* DE GREGORIO, Annales Géologie paléontologie, vol. 7, p. 23.

TYPE, BY SUBSEQUENT DESIGNATION (Cossmann, Essais paléoconchologie comp., vol. 2, p. 78, 1896): *Pleurotoma acutirostra* Conrad, 1835 = *Pleurotoma childreni* Lea, 1833.

Shell small, turriculate; the whorls angular, the periphery in many species outlined by a double spiral; protoconch of 2 or more smooth rapidly enlarging whorls succeeded by one or more convex whorls adorned with numerous obliquely arcuate costae. Both axial and spiral sculpture on the conch, the axial tending to be oblique, the spiral most prominent on the periphery and in front of it; body constricted rather abruptly into a narrow, straight, and fairly short canal; aperture narrow; siphonal fasciole rather shallow, following the periphery.

*Coronia* includes the compact assemblage of Gulf Eocene turrids characterized by the rather large, conic, multispiral protoconch in which the earlier whorls are smooth, the later costate; by the slender fusoid conch, both the axial and spiral sculpture strongest upon the periphery; and by a siphonal notch, broad and not remarkably deep, following the periphery of the whorl as in true *Pleurotoma*.

Harris (1937) considered *Coronia* De Gregorio as a synonym of *Gemmula* Weinkauff and advanced as an argument for the nonrecognition of *Coronia* the heterogeneous character of the group of species included under it in De Gregorio's original description. De Gregorio did not designate his type, though Cossmann says he did ("notre confrère sicilien a pris comme type de son sous-genre *Pl. acutirostra*, Conr. de Claiborne", a statement which may in itself be accepted as a type designation). The illustrations both of Conrad's *acutirostra* and of Lea's *childreni* are unsatisfactory, but they seem to be nothing more than individual variations of a single species abundant in the Claiborne sand. The protoconch of *Pleurotoma childreni* includes 2 smooth initial whorls, of which the first is largely submerged, and from 2 to 2½ succeeding whorls that are relatively large and axially costate. The costae are arcuate and range from 15 to 20 to the whorl. The nucleus of *Gemmula*, the genus with which *Coronia* De Gregorio has been considered synonymous, is relatively smaller and more acute, the canal is decidedly longer, and the fasciolar notch a peripheral slit. The genotype of *Gemmula*, *G. gemmata* Hinds, is a species described, presumably from Magdalena Bay, Lower California, but is, according to Tryon, an Indo-Pacific shell. The close relationship of *Gemmula* Weinkauff, typified by a Recent Pacific species, to a group of lower Tertiary Gulf turrids is extremely dubious, and *Coronia* has been retained to include most species referred by various workers to *Gemmula*.

The conchs of *Coronia* and of *Hesperiturris* may be similar in general aspect and sculpture pattern, but if the nuclear whorls are preserved the two groups may readily be discriminated. The nucleus of *Coronia* is large and blunt, and the later nuclear whorls axially costate; that of *Hesperiturris* is smooth, except for the final costate whorl.

*Coronia?* sp.

A single spire of a many-whorled gastropod, probably a turrid, is impressed in the fine indurated sandstone of the upper part of the Indio formation in the Arroyo Santo Domingo at U.S.G.S. sta. 13689 (E-5). The whorls are narrow and corded directly in front of the suture; a concave depression directly in front of the cord, and on the medial and anterior portions of the whorl about 12 knobby ribs overridden by about 5 spiral threadlets. The spire recalls the group of "*Pleurotoma Childreni*" Lea.

The fragmentary adolescent, U. S. Nat. Mus. 559394 from the middle Laredo at U.S.G.S. sta. 13567 (Plate 25, figure 12), does not exhibit the typical *Coronia* sculpture, and the protoconch has been lost. Generic determination is impossible, but the shell seems to have more in common with *Coronia* than with any other group.

*Coronia margaritosa* (Casey)?

(Plate 27, figure 7)

Synonymy and description of *Coronia margaritosa* (Casey):

1904. *Gemmula margaritosa* CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 135.

1937. *Gemmula margaritosa* CASEY. HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 16, pl. 2, figs. 14, 15, 17.



"Whorls with two rather widely separated carinae below the suture; embryo relatively small in size, somewhat higher than wide, with about three small smooth apical whorls, gradually increasing as usual, and two whorls covered with coarse and rather widely spaced riblets; peripheral duplex carina not strongly elevated, the space between it and the lower and larger of the subsutural carinae about twice as wide as the peripheral band and having two spiral threads and sometimes three other smaller ones in addition; space below the periphery with several spiral carinules; shell rather large, the beak straight but somewhat feebly, obliquely swollen toward tip; length of the aperture and canal together nearly two-fifths the length of the shell. Length of a specimen having 9 body whorls, 27 mm.; width, 7.3 mm. Lower Claiborne Eocene of Smithville [Smithville], Texas." Casey, 1904.

The specimen from Hickory, Mississippi, figured by Harris (1937, pl. 2, fig. 16), does not show the characteristic smoothness of outline of *C. margaritosa*, and the spirals are fewer and coarser than in the form from Smithville. The illustrated fragment of 5 whorls is too imperfect for certain identification, but no characters by which it can be separated from the Texas species have been preserved.

DIMENSIONS (U. S. Nat. Mus. 497263): Height, 9.2 millimeters; diameter, 4.5 millimeters.

LOCALITY: U.S.G.S. sta. 13596 (H-15), China, Carlos Cantú, Nuevo León. Lower part of Laredo formation.

### *Coronia genetiva* (Casey)?

(Plate 25, figures 9, 11)

Synonymy and description of *Coronia genetiva* (Casey):

1904. *Gemmula genetiva* CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 135.

1937. *Gemmula genetiva* Casey. HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 15, pl. 2, fig. 11.

"Peripheral double carina distinctly below the middle of the whorls, broader, the denticulation coarser and more close-set; form not quite so slender though about equal in length to *rotaedens*; aperture and canal combined more than a third of the total length. Length of a specimen having 6 body whorls, 11.5 mm.; width, 3.4 mm. Lower Claiborne Eocene of Lee Co., Texas." Casey, 1904.

HOLOTYPE: U. S. Nat. Mus. 494347.

Casey's holotype does not look like an adult individual. The Claiborne section in Lee County, the locality at which the type was collected, is exceptionally complete, and fossiliferous beds have been recognized from the Weches member of the Mount Selman formation up to the Yegua formation. The Mexican shell (Plate 25, figure 9), U. S. Nat. Mus. 497430 from U.S.G.S. sta. 13861 (H-4), closely resembles the holotype and, like it, is probably immature. Another figured juvenile (Plate 25, figure 11), U. S. Nat. Mus. 497431 from U.S.G.S. sta. 13643 (M-25), is more closely noded and more finely lirate spirally and probably represents a related but distinct species, referable to *Coronia*. One of the two examples from U.S.G.S. sta. 13565 (H-12) approaches maturity, but the sculpture is badly rubbed. All the shells are from the middle part of the Laredo formation.

### Genus *Cochlespira* Conrad

1865. *Cochlespira* CONRAD, Am. Jour. Conchology, vol. 1, p. 19.

TYPE, BY SUBSEQUENT DESIGNATION (Cossmann, Essais paléoconchologie comp., vol. 2, p. 68, 1896): *Cochlespira engonata* Conrad. Lower Claiborne of Claiborne and Texas.

The genus includes small, slender, fusiform shells with conspicuously crenate peripheries, a greater or less development of a beaded spiral sculpture but no axial ribbing, and a deep, broadly U-shaped sinus symmetrically disposed on the periphery. The protoconch is small, slender, and acutely tapering.

The rather involved nomenclature of the group has been discussed by various authors.

### *Cochlespira bella* Conrad

(Plate 15, figure ?15)

1865. *Cochlespira bella* CONRAD, Am. Jour. Conchology, vol. 1, p. 210, pl. 21, fig. 6.

1904. *Cochlespira bella* Conrad. CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 144.

1937. *Cochlespira bella* Conrad. HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 46, pl. 9, figs. 4, 5.



"Fusiform, turritid, whorls 10, with an acute reflexed subspinose carina, and crenulated revolving lines.

"Differs from *C. cristata*, Conr., in having fewer and coarser lines, and a more prominent carina.

"*Locality*.—Texas." Conrad, 1865.

The single battered specimen (U. S. Nat. Mus. 497116) from the lower part of the Laredo formation at U.S.G.S. sta. 13596 (H-15), China, Carlos Cantú, Nuevo León, retains traces of a secondary spiral in front of the periphery both on the later whorls of the spire and on the body and of a prominent beaded spiral both directly in front of and directly behind the suture, and similar to analogous spirals on the conch of *Cochlespira bella*. The specimen is only 4 millimeters in diameter and is too worn for certain identification, but those characters which are retained can be matched in examples of Conrad's species from the Weches fauna of Smithville, Texas.

### *Cochlespira* sp.

(Plate 25, figure 6)

A single fragment, too imperfect to be named but sufficiently well preserved to establish its lack of conformity to any described species, is present in the lower part of the Laredo formation near China, Carlos Cantú, Nuevo León. Two small, smooth nuclear whorls are still retained, but the extreme tip has been lost. On the  $7\frac{1}{2}$  postnuclear whorls, the shoulder is broad and gently sloping to the strongly crenate periphery. In front of the periphery, the whorl is constricted. A single beaded spiral adorns the whorl between the periphery and the anterior suture; on the earlier whorls, the suture follows this spiral; later, a second spiral appears in front of the first. Three subequal, conspicuously heavy spirals gird the body in front of the periphery supplemented at the base by remnants of finer spirals. The shoulder is smooth except for a beaded cord directly in front of the suture. The posterior sinus is obscured, but apparently it was symmetrical on the shoulder. The anterior canal is broken away.

DIMENSIONS (U. S. Nat. Mus. 497423): Height, 11 millimeters; diameter, 5 millimeters.

LOCALITY: U.S.G.S. sta. 13600 (H-15), 5.7 kilometers S.  $23^{\circ}$  E. of General Bravo, Carlos Cantú, Nuevo León. Lower part of Laredo formation.

In Conrad's *Cochlespira bella*, described from Texas, a secondary is, as a rule, introduced on the later adult whorls between the periphery and the anterior spiral. There is no trace of a secondary striation on the Mexican specimen, and the body spirals are more numerous, stronger, and more uniform in size and spacing than they are on the Texas individuals. Certainly the two forms are specifically distinct, and it is unfortunate that the Mexican material is not sufficiently good to warrant further identification.

### Genus *Surculoma* Casey

1904. *Surculoma* CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 153.

TYPE, BY ORIGINAL DESIGNATION: *Pleurotoma tabulata* Conrad. Claiborne, Ala.

"In *Surculoma* the beak is rather slender and somewhat abruptly formed below the convexity of the body whorl, the ribs large and few in number, the spire whorls always more or less angulate in profile at the periphery and the sculpture invariably consists of minute and very close-set spiral lines. . . . There are four species of *Surculoma* known to me at present, described under the names of *tabulata* Con. (= *coelata* Lea)—assumed as the generic type—from the Upper Claiborne sand and *penrosei* and *dumblei*, of Harris, and *stantoni* Vaughan, from the Lower Claiborne of Texas and Louisiana. *Penrosei* Harr., which was published by its author as a variety of *huppertzi*, is in no way closely related to that species, having a radically different embryo as well as a different position of the anal sinus. *Dumblei* is more slender and has a relatively higher spire and shorter aperture than the others, but does not differ otherwise. *Subaequalis*, of Conrad, may possibly be an aberrant species of this genus, although the periphery is decidedly more obtuse; it seems to have the same peculiar minute close-set spiral lines, which, in all the species, alternate with larger lines toward base; it is very stout in form, with short obtuse rounded ribs, the aperture and short slender canal together being fully as long as the remainder of the shell if not longer. The embryo is wanting in the type and apparently only known specimen, which is from the Upper Claiborne sand. A very large and conspicuous umbilicus occurs in *tabulata* as an abnormal character." Casey, 1904.



"*Pleurotoma*" *servatoidea* Aldrich (Plate 25, figures 18, 21) from the Wilcox of Alabama is similar in general form and sculpture pattern to *Surculoma* but differs in the characters of the protoconch and in the position of the retral sinus which coincides with the periphery of the whorl and not with the shoulder as in *Surculoma*.

*Surculoma* sp.

(Plate 25, figure 13)

Shell of moderate dimensions, the aperture in the perfect specimen probably half the height of the shell, the whorls of the spire obtusely angulated at the periphery, and acutely tapering. Protoconch lost. Early whorls of conch axially sculptured with 8 oblique, protractive riblets, rather narrow, originating near the posterior suture and produced to the anterior; axials away from the apex becoming more swollen and nodose, undulatory, and reduced in number by 1 or 2; on the later turns, largely restricted to the peripheral area. Spiral sculpture, for the most part obliterated by the weathering of the shell; a well-defined sutural cord; 3 strong and regularly spaced primaries on the sides of the whorls of the spire and twice as many on the body; faint traces of finer intercalated spirals and of fine threading on the base of the body and the canal, and possibly on the shoulder. Shoulder broadening with the growth of the shell, undulated by the axials and exhibiting traces of a broad U-shaped notch symmetrical between the suture and the periphery. Anterior canal probably rather long, the pillar straight and free from folds.

DIMENSIONS OF IMPERFECT SPECIMEN (U. S. Nat. Mus. 497428): Height, 21 millimeters; diameter, 9 millimeters.

LOCALITY: U.S.G.S. sta. 13567 (H-11). Middle part of Laredo formation.

The form and the axial sculpture are similar to that of *Surculoma penrosei* Harris, but the spirals are much coarser and less numerous. Though too poorly preserved to name, it indicates the presence of *Surculoma* in the mid-Eocene fauna of northeastern Mexico.

Genus *Trypanotopsis* Gardner, n. gen.

TYPE, BY ORIGINAL DESIGNATION: *Turris texana* Gabb. Lower Claiborne of Texas.

Shell small, slender, acutely tapering. Body, including the short but distinctly differentiated canal, more than half as high as the entire shell. Protoconch obtuse, paucispiral, and in the genotype devoid of sculpture. Axial riblets of conch obtuse, slightly protractive, dying out completely before the final whorl of the adult; spirals flattened, irregular in size and spacing. Posterior siphonal notch broad, not very deep, placed well forward. Aperture narrow, the outer lip flaring slightly vertically, smooth within. Parietal wash fairly heavy. Pillar not plicate, bent slightly near its extremity. Anterior fasciole a little swollen, finely lirate, truncate.

The genotype, *Turris texana* Gabb, has been included by Casey (1904) and Harris (1937) under *Asthenotoma* Harris and Burrows, 1891, a replacement name for *Oligotoma* Bellardi, 1875, not *Oligotoma* Westwood, 1836. The type of *Oligotoma Bellardi* is *Pleurotoma meneghinii* Mayer, 1868, from the Tortonien of Sassuolo near Modena. It was described as a thick, solid shell, 27 millimeters high, with convex tuberculate whorls; the tubercles not restricted to the early spire but persistent to the aperture. There is no example of *P. meneghinii* in our collections, but an excellent figure accompanies the original description and pictures a shell only distantly related to *Trypanotopsis texana*. The view is from the rear so that the characters of the aperture are not revealed. Mayer speaks of the canal as "court et légèrement tordu." He makes no mention of a columellar fold, but Bellardi in his generic description speaks of the pillar as uniplicate. In general form and dimensions, *T. texana* resembles the genotype of *Trypanotoma*, *Pleurotoma terebriformis* Meyer, described from the Gosport sand at Claiborne. Possibly Meyer had *T. texana* in mind when he cited Wheelock, Texas, as one of the localities from which *terebriformis* had been recovered. The relationship between the groups may be close, for the nuclear characters and the characters of the retral sinus and of the aperture are similar, but the sculpture of *Trypanotoma* recalls that of *Coronia* of the *childreni* group, while the axials of *Trypanotopsis* are few and swollen and have nothing to do with the incremental sculpture.



*Trypanotopsis texana* (Gabb)

(Plate 27, figure 15)

1860. *Turris texana* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 379, pl. 67, fig. 9 (fig. 11 in text, by error).  
 1865. *Surcula texana* GABB, Am. Jour. Conchology, vol. 1, p. 19.  
 1904. *Asthenotoma texana* Gabb. CASEY, Acad. Sci. St. Louis, Trans., p. 149.  
 1931. *Pleurotoma texana* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 95, 100.  
 1936. "*Pleurotoma*" *texana* Harris. STENZEL, Univ. Texas Bull. 3501, p. 276.  
 1937. *Asthenotoma texana* (Gabb). HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 86, pl. 14, figs. 8, 9.

"Narrow fusiform, whorls eleven or twelve; mouth narrow, canal short, straight, outer lip simple, inner lip slightly thickened; surface marked by about twenty revolving lines, two small ones on the shoulder of the whorl and the remainder larger and decreasing from the shoulder towards the end of the canal; traces of longitudinal ribs exist obscurely on the first half dozen whorls.

"*Dimensions*.—Length .7 in., length of mouth .3 in., width of body whorl .2 in." Gabb, 1860.

HOLOTYPE: Acad. Nat. Sci. Philadelphia 13289.

TYPE LOCALITY: Wheelock, Texas.

The figured specimen, U. S. Nat. Mus. 497265, from U.S.G.S. sta. 13454 (H-15), is 10.5 millimeters high and 3.6 millimeters wide. The shell is not complete. The species has been recognized only at the single locality in the lower part of the Laredo formation.

The protoconch is obtuse and includes not more than 2 volutions, the earlier slightly tilted, swollen, and submerged at the tip. The axials are introduced with the beginning of the conch, and the earlier whorls of the spire are rippled with about 9 or 10 slightly protractive riblets, which on many individuals do not become altogether obsolete until the body whorl is reached. The spirals are somewhat flattened and more or less irregular in size and spacing. The siphonal notch is a broad spreading U placed well forward. The later whorls are flattened so that there is no keel, but on the earlier, slightly inflated whorls the axis of the notch follows the periphery, and on the later whorls it occupies an analogous position. The aperture is narrow, the outer lip flaring vertically and smooth within. The pillar bears no trace of a fold, but there is a slight warp at its extremity.

*Trypanotopsis texana* is uncommonly well characterized by the small, slender, acutely tapering shell, the obtuse, undulating axial sculpture not persistent over the entire shell, and the flattened and irregular spirals.

It is one of the diagnostic species of Stenzel's proposed Stone City beds directly overlying the *Ostrea sellaeformis* zone.

Genus *Pleurofusua* De Gregorio

1890. *Pleurofusua* DE GREGORIO, Annales géologie paléontologie, vol. 7, p. 33.

TYPE, BY ORIGINAL DESIGNATION: *Pleurotoma* (*Pleurofusua*) *longirostropsis* De Gregorio. Claiborne of Alabama.

*Pleurofusua* includes a group of slender, fusoid shells either small or of moderate dimensions. The nucleus is blunt and paucispiral, for the most part smooth, but with a few axial riblets on the final quarter turn. The conch is axially fluted, the swollen ribs tending to be opposite and protractive on the consecutive whorls. The spiral lirations are typically few in number, prominent, and equally vigorous on the axial and interaxial areas. The fasciole is concave, more or less undulated by the weakening axials, and with no conspicuous spiral sculpture except the sutural cord. The growth lines are bent backward around the retral sinus in a broad shallow notch with the axis of the sinus slightly closer to the periphery than to the posterior suture. The aperture is narrow, the anterior canal rather short.

*Pleurofusua collaris* Casey

1903. *Pleurotoma collaris* CASEY, Acad. Nat. Sci. Philadelphia, Proc., p. 270.  
 1904. *Pleurofusua collaris* CASEY, Acad. Sci. St. Louis, Trans., pp. 127, 152.  
 1937. *Pleurofusua collaris* Casey. HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 52, pl. 10, fig. 8.

"This is the second species from Moody's Branch referred to under the preceding description. It is stouter, with a still shorter canal, the aperture and canal together constituting about two-fifths



the entire length of the shell. The nucleus is small, obtuse and of about two whorls. Body whorls about seven in number, each with some seven or eight obtuse ribs and a wide and strongly elevated conspicuous collar just below the suture, the upper surface of the collar declivous to the suture and having two close-set revolving striae, the lower part acutely elevated. The surface below the collar is deeply concave, then rapidly expanding to the posterior of the three strong raised lines which occupy about anterior half of the whorl. The concavity is marked with many very fine close-set revolving lines and the spaces between the three large lyrae referred to also have each about three fine lines. Length 17 mm., width 6 mm." Casey, 1903.

HOLOTYPE: U. S. Nat. Mus. 481668.

TYPE LOCALITY: U.S.G.S. sta. 13290, Jackson, Mississippi. Jackson formation.

The spiral lirations are more numerous and less prominent on *collaris* than on the genotype. The Mexican species is more slender and more acutely tapering than Casey's holotype, but the differences may be individual.

DISTRIBUTION: Jackson formation: upper Jackson, ?U.S.G.S. sta. 13513 (M-11).

### *Pleurofusua vicksburgensis* Casey

1903. *Pleurotoma vicksburgensis* CASEY, Acad. Nat. Sci. Philadelphia, Proc., p. 268.

1904. *Pleurofusua vicksburgensis* CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 152.

1937. *Pleurofusua vicksburgensis* Casey. HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 51, pl. 10, fig. 3.

"This species occurs plentifully in the Vicksburgian beds, accompanying *servata* and generally confounded with it. It usually attained a little larger size and stouter form, and may be distinguished at once by the fact that the whorl immediately adjoining the nucleus has a strong revolving line below the middle, thickened on the ribs and accompanied by a close-set smaller revolving line immediately above it. The larger whorls generally acquire two other coarse, though much smaller revolving lines, one above and one below the two mentioned, and also finer intermediate threads. Just below the suture the elevated collar is not quite so prominent as in *servata*, and, instead of the abrupt concavity adjoining, the surface is almost evenly concave and rapidly expanded to the system of coarse revolving lines referred to, this surface being also finely, evenly lyrate. The nucleus is much shorter than in *servata*, consisting of between two and three whorls, and is not higher than wide. The aperture and canal are nearly as in *servata*. One of the larger specimens before me measures 27 mm. in length by 7 mm. in width. The double carina of the nepionic whorls remains throughout the most conspicuous feature of the revolving sculpture, the lines becoming gradually more nearly equal and more widely spaced, with the dilatations on the ribs much more pronounced than in *servata*; the ribs, also, are much more broadly rounded than in that species and become obsolete in the posterior concave area of the whorls." Casey, 1903.

LECTOTYPE FIGURED BY HARRIS: U. S. Nat. Mus. 481670.

A specimen exhibiting the characteristic features of the conch but unfortunately lacking the protoconch was recovered from the lower marine Oligocene sandstone at U.S.G.S. sta. 13510 (M-11).

### Genus *Pleuroliria* De Gregorio

1890. *Pleuroliria* DE GREGORIO, Annales géologie paléontologie, vol. 7, p. 38.

1928. *Pleuroliria* De Gregorio. WOODRING, Carnegie Inst. Washington, Pub. 385, p. 145.

TYPE, BY ORIGINAL DESIGNATION: *Pleurotoma (Pleuroliria) supramirifica* De Gregorio. Claiborne Eocene of Alabama.

Shell rather small for the group, spindle-shaped, polygyrate. Four or more nuclear whorls, the later turns ribbed with numerous arcuate axials; close of protoconch indicated by the abrupt disappearance of the axial sculpture and the equally abrupt appearance of the spiral. Conch spirally threaded and corded but without axial sculpture other than the prominent growth laminae. Aperture narrow, obliquely lenticular, posteriorly constricted into the rather long, straight, unemarginate canal with parallel, proximate sides. Outer lip flaring incrementally, thin and crenate at the edge, lirate within, the lirae not persistent, however, to the margin of the lip. Parietal wall glazed. Anal notch moderately deep, the base of the notch following the heavy spiral that outlines the periphery of the whorl.

There is no example of De Gregorio's type in our extensive collections from the Claiborne group. The suspicion must arise that he had before him an example of *Pleurotoma cochlearis* Conrad from the Byram marl of Vicksburg, Mississippi, but there is no proof.



*Pleuroliria* resembles *Polystira* Woodring, of the Tertiary and Quaternary mid-American fauna, in the postnuclear shell. The nucleus of *Pleuroliria*, however, includes 4 or more whorls, the later whorls with a well-defined axial sculpture: that of *Polystira*, only half as many volutions, and the axial ribbing feeble and confined to a fraction of the last whorl. Woodring noted the distinction and considered that the difference between the smaller, less prominently keeled early Tertiary group and that from the later Tertiary and Recent was sufficiently great to be recognized in the nomenclature.

#### Section *Josephina*, n. sect.

TYPE: *Pleuroliria tenagos* GARDNER. Shoal River formation, Middle Miocene, of Florida.

The section is proposed to include those *Pleuroliria* of medium or relatively large dimensions with protoconchs of 4 or more whorls and conchs with spiral cords so prominent that they contour the whorls.

Woodring defined the limits of the group in 1928 (Carnegie Inst. Washington, Pub. 385, p. 145), but because my species, which was the best example of the group, was then in manuscript form he most courteously delayed naming it.

"A branch of this early Tertiary genus is represented by a species from the middle Miocene Shoal River formation of Florida, described in manuscript by Gardner. It has a nucleus resembling that of *cochlearis*, though the number of whorls is reduced to a little less than four, but the shell is larger and the peripheral keel is stronger, so that except for the nucleus it resembles the still larger species of *Polystira*. If the arrangement here proposed is worth anything, this species should be placed in a subgenus under *Pleuroliria*. This same subgenus is represented by living species in the Panamic and Mazatlanic regions (*'Pleurotoma'* *picta* Reeve and *'Pleurotoma'* *albicarinata* Sowerby), but the number of nuclear whorls is again reduced to three or a little less than three. Both these species are smaller than the West Indian species and they are comparable in size to the Shoal River fossils. So far as can be discovered all the living West Indian species fall in *Polystira*, though *Pleurotoma albida* var. *tellea* Dall has relatively weak keels." Woodring, 1928.

The section, recognized only in the later Tertiary and Quaternary faunas, seems to be a development from the smaller, less decisively sculptured *Pleuroliria cochlearis* (Conrad) of the Oligocene. Possibly the striking resemblance of the conchs of the section *Josephina* to those of the genus *Polystira* Woodring may be due to homeomorphy.

This group is named for Josephine Woodring.

#### *Pleuroliria tenagos* Gardner

1928. *Pleuroliria* sp. WOODRING, Carnegie Inst. Washington, Pub. 385, p. 145.

1937. *Polystira* (*Pleuroliria*) *tenagos* GARDNER, U. S. Geol. Survey, Prof. Paper 142-F, p. 288, pl. 38, figs. 25, 26.

*Pleuroliria tenagos* is the most abundant representative of the family at Shoal River, Florida.

The Mexican material is inadequate for assured determination, but the form of the shell is similar to *Pleuroliria tenagos* rather than to the species from the lower formations of the Alum Bluff group.

DISTRIBUTION: Guajalote formation: ?U.S.G.S. sta. 13588 (W-30).

#### Genus *Hemisurcula* Casey

1904. *Hemisurcula* CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 150.

TYPE, BY ORIGINAL DESIGNATION: *Pleurotoma silicata* Aldrich (Plate 25, figures 19, 20) from the Tusahoma formation of the Wilcox group at Gregg's Landing, Alabama.

"In this genus the shell is fusiform, with the embryo conoidal, multispiral and closely coiled, the nepionic spire whorls alone costate and having also an elevated collar below the suture. The more recent whorls become devoid of lyrae or costae, though having throughout densely close-set and subequal microscopic striae, except the body whorl abruptly below the posterior end of the aperture, which is obliquely and rather coarsely lyrate. The canal is moderate, straight, and, together with the aperture, forms about half the length of the shell. The sinus is broadly rounded and median in position on the spire whorls, the columella simple. The type of this genus is *Pl. silicata*, of Aldrich, a very remarkable and isolated species occurring in the Lignitic Eocene of the Gregg's Landing beds of Alabama. The beaded subsutural collar, subjacent depression and swollen and finely ribbed lower parts of the two whorls immediately below the embryo are lost completely on the larger whorls, though the subsutural collar can be feebly traced as a slightly tumid line gradually descending further below the suture with the growth of the shell." Casey, 1904.



In the Aldrich type of *Pleurotoma silicata* (Plate 25, figures 19, 20) which is fortunately available for comparison, the later whorls are obscurely shouldered, and the axis of the sinus falls a little behind the outer margin of the shoulder, not midway upon it as in the old *Surcula* nor squarely upon the periphery as in "*Pleurotoma*." *Pleurotoma roscoe* Harris, the only other species referred by Casey to *Hemisurcula*, and also from Gregg's Landing, suggests in the description and the figure a buccinoid rather than a turrid. However, the type has not been examined.

*Hemisurcula eosilicata* Gardner, n. sp.

(Plate 25, figure 4)

Shell slender fusiform, only the final 4 and a fragment of the fifth whorls remaining. Posterior portion of the whorls obliquely flattened and set off from the more rounded anterior half of the whorl by an obscure angle. Apical whorls not preserved on the type. No axial sculpture recorded on the later whorls. Entire surface crowded with exceedingly fine spiral lines, not sharp and regular but minutely waved by the incrementals; about 8 to the millimeter on the whorls of the spire and the anterior portion of the body; wider and a little less faint on the base of the body and the canal. Suture line distinct, impressed. Body broadly rounded and tapering evenly into the slender canal. Aperture not quite half the total height of the shell, filled with matrix; characters of the outer and inner margins lost. Sinus very deep, constricting into a rather narrow U, its axis a little behind the outer margin of the shoulder. Extremity of anterior canal broken.

DIMENSIONS OF IMPERFECT HOLOTYPE: Height, 45 millimeters; maximum diameter, 13 millimeters.

HOLOTYPE: U. S. Nat. Mus. 494963.

TYPE LOCALITY: U.S.G.S. sta. 13459 (B-6), 5.5 kilometers south-southeast of Agualeguas, near Loma Comales, Nuevo León. Lower part of Midway formation.

*Hemisurcula eosilicata* has lost, unfortunately, some of the diagnostic features of the genus, but it so closely resembles the genotype in the characters that have been retained, and the missing features are so clearly indicated on a fragmentary adolescent, that a genetic relationship between the Mexican and the Alabaman forms may be postulated. The Alabama species is only about half the size of that from Mexico, the spiral threading is less uniform, and the angulation at the outer margin of the shoulder even more obscure.

DISTRIBUTION: Midway formation: lower Midway U.S.G.S. sta. 13459 (B-6); U.S.G.S. sta. 13473 (B-6).

Genus *Microdrillia* Casey

1903. *Microdrillia* CASEY, Acad. Nat. Sci. Philadelphia, Proc., p. 276.

TYPE, BY SUBSEQUENT DESIGNATION (Cossmann, Essais paléoconchologie comp., vol. 7, p. 223, 1906): *Pleurotoma cossmanni* Meyer, not De Raincourt. Eocene of Jackson, Mississippi.

"A number of minute Pleurotomids, including *infans* and *cossmanni* of Meyer and *harrisi* of Aldrich, have been referred to by Cossmann under the names *Asthenotoma* and *Scobinella*, by Harris under *Mangilia*, by Aldrich under *Glyphostoma*, and by Meyer, Vaughan, and others under *Pleurotoma* in its broad sense. They are all very small and characterized by a well-developed multispiral, closely coiled embryo, having 1 to 3 of its basal whorls costulate, few body whorls which are wholly devoid of costae but spirally carinate, the retral sinus relatively large, circularly rounded and close to the suture, the aperture oblique, columella callous, with or without plications, and the canal short or subobsolete.

"The genus *Microdrillia* differs from *Asthenotoma*, to which *cossmanni* was referred by Cossmann, in the structure of the embryo and especially in the position of the retral sinus, which in *Asthenotoma* corresponds in its greatest depth with the median line or periphery of the whorls. . . . *Microdrillia* is much more closely related to *Glyphostoma*, as suggested by Aldrich, but not at all allied to *Mangilia*. It appears to have become wholly extinct in the Oligocene or lower Miocene. The species were numerous and individually abundant, especially in the mid-Eocene of the lower Claiborne." Casey, 1903.

*Microdrillia harrisi* (Aldrich)

1895. *Glyphostoma harrisi* ALDRICH, Bull. Am. Paleontology, vol. 1, no. 2, p. 9, pl. 1, fig. 11.

1903. *Microdrillia harrisi* (Aldrich). CASEY, Acad. Nat. Sci. Philadelphia, Proc., p. 278.

1903. *Microdrillia aldrichiella* CASEY? Acad. Nat. Sci. Philadelphia, Proc., p. 278.



1931. *Glyphostoma harrisi* Aldrich. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 100, 106.  
 1937. *Microdrillia harrisi* (Aldrich). HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 91, pl. 14, figs. 27-30, 44.

"Shell small, whorls nine, spire acuminate, suture deeply impressed; the first four whorls smooth, the next two with longitudinal beads, balance with strongly raised spirals; suture bounded by a cord above and below, followed by a broad excavated space corresponding to the fasciolar space; lines on the last half of the body whorl with an intercalary thread; aperture narrow, outer lip slightly incurved, striate within; pillar lip thickened and bearing two (in the type) to six small plaits; umbilicus rudimentary.

"*Locality*.—Wheelock, Texas, also in Lee and Burleson Co's.

"The figure is a little too broad.

"This species is placed by Mr. Harris under *P. infans* Meyer, but it seems to me to be a very different species as the latter has no plaits on the columella, is narrower, has fewer whorls and a twisted canal." Aldrich, 1895.

The type is in the Aldrich collection in the Paleontological Laboratory at Johns Hopkins University, Baltimore, Maryland.

The two specimens figured by Harris, presumably the types of *M. aldrichiella* Casey (U. S. Nat. Mus. 481593) are worn individuals which seem to differ from *M. harrisi* (Aldrich) in the characters of the protoconch. Our Mexican material is meager, but the nuclear characters are those of typical *harrisi*. Harris may have correctly referred *aldrichiella* to the synonymy of *harrisi*, but it seems more probable that there are differences which should be recognized in the taxonomy. In any case the relationship must be established by a consideration of the Texas suite.

DISTRIBUTION: Laredo formation: middle Laredo, ?U.S.G.S. sta. 13861 (H-4).

#### Genus *Glyptotoma* Casey

1904. *Glyptotoma* CASEY, Acad. Sci. St. Louis, Trans., vol. 14, p. 140.  
 1937. *Glyptotoma* Casey. HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 23.

TYPE, HERewith DESIGNATED: *Scobinella crassiplicata* Gabb. Lower Claiborne of Texas.

"Some peculiar small species generally of robust form, having a narrow tumid columella ridge, which is strongly bi- or triplicate and the anal sinus median in position and formed upon a broad double nodose spiral, require separation as a distinct genus for which I would propose the above name. The general type of tessellated ornamentation is strikingly similar to that characterizing *Scobinella*, and the aperture, canal and embryo are of corresponding form, but the anal sinus is wholly different in form and position and the outer lip is not advanced and arcuately lobed. They have occurred thus far only in the Lower Claiborne Eocene of Texas." Casey, 1904.

Harris treated *Glyptotoma* as a section of *Bathytoma*, but the type of *Bathytoma*, *Murex cataphractus* Brocchi, from the upper Miocene and Pliocene of Italy and the Paris Basin, is a shell between 50 and 60 millimeters high, with a single feeble pillar plication that scarcely reaches the aperture. *Glyptotoma* suggests a dwarf *Scobinella* except in the position of the retral sinus, which falls on the noded peripheral girdle and not on the shoulder, as it does in *Scobinella*.

#### *Glyptotoma crassiplicata* (Gabb)

1860. *Scobinella crassiplicata* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 380, pl. 67, fig. 19.  
 1865. *S[cobinella]? crassiplicata* Gabb. CONRAD, Am. Jour. Conchology, vol. 1, p. 20.  
 1891. *Scobinella crassiplicata* Gabb. HEILPRIN, Acad. Nat. Sci. Philadelphia, Proc. for 1890, p. 395.  
 1895. *Borsonia* (*Scobinella*) *conradiana* ALDRICH, Bull. Am. Paleontology, vol. 1, no. 2, p. 8, pl. 1, fig. 13.  
 1904. *Glyptotoma crassiplicata* Gabb. CASEY, Acad. Sci. St. Louis, Trans., p. 141.  
 1904. *Glyptotoma conradiana* Aldrich. CASEY, Acad. Sci. St. Louis, Trans., p. 141.  
 1931. *Scobinella conradiana* Aldrich. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 100.  
 1937. *Bathytoma* (*Glyptotoma*) *crassiplicata* (Gabb). HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 23, pl. 3, figs. 27-30.  
 1937. *Bathytoma* (*Glyptotoma*) *conradiana* (Aldrich). HARRIS, Palaeontographica Americana, vol. 2, no. 7, p. 23, pl. 3, figs. 31, 32; pl. 4, figs. 1, 1a?

"Fusiform, robust; spire straight on the sides; mouth about half the length of the shell, canal straight; umbilicus rudimentary; surface marked by revolving ribs, one narrow nodose rib at the top of the whorl, one wider nodose rib sometimes double on the shoulder, and numerous smaller plain ribs crossing the remainder of the whorl and alternating in size: the nodes on the first two ribs, which are



somewhat wider than exhibited on the figure, give this shell a strongly cancellated appearance to the naked eye.

"*Dimensions*.—Length .3 in., length of mouth .16 in., width of body whorl .13 in." Gabb, 1860.

HOLOTYPE: Acad. Nat. Sci. Philadelphia 13282.

TYPE LOCALITY: Wheelock, Robertson County, Texas.

This solid little species is exceptionally well characterized by the heavy noded spirals and by the advanced position of the siphonal notch. The small, blunt protoconch includes between 3 and 4 smooth, shining whorls with the initial turn almost entirely immersed.

DISTRIBUTION: Laredo formation: lower Laredo, U.S.G.S. sta. 13968 (I-19).

#### Genus *Scobinella* Conrad

Jan. 1848. *Scobinella* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 289.

Aug. 1848. *Scobinella* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 120.

TYPE, BY MONOTYPY: *Scobinella coelata* Conrad. Vicksburg, Mississippi.

The shell is, as a rule, moderately large and slender, with an aperture a little less than half as high as the entire conch. The protoconch includes about 3 smooth rapidly tapering whorls, the initial turn for the most part submerged, followed by rather less than half a whorl on which axial ribbing is well developed. The sculpture of the conch consists of heavy flattened spirals dissected by an exaggerated incremental sculpture. The sutural cord is fairly strong, the shoulder moderately wide and slightly concave, the anal notch broadly U-shaped and placed squarely on the shoulder. The aperture is narrow, the outer lip liriate within, the parietal and pillar wash thin. The pillar bears 2 or more folds which take the same direction as the spirals that gird the pillar and tend to become increasingly strong posteriorly. The anterior canal is moderately long and not very slender; it merges with no sharp break into the body and is truncate at its extremity.

The genus is particularly characteristic of the Eocene and Oligocene faunas of the Gulf Province. It has not been recognized in the post-Oligocene deposits of the States, but three species have been recorded from the Miocene of the Canal Zone and the Dominican Republic. Possibly the group was exceptionally sensitive and was unable to withstand the lower temperatures under which the Miocene and Pliocene deposits of the mainland were laid down.

#### *Scobinella?* sp.

A fragment of a species (U. S. Nat. Mus. 497426) recalling *Eucheilodon* in form and sculpture pattern but resembling *Scobinella* in the position of the retral sinus and the plication on the pillar has been recovered from the calcareous sandstones of the upper Jackson at U.S.G.S. sta. 14009 (M-13), in Zacate, Nuevo León. Only the two last whorls of the spire and the body, exclusive of the pillar, remain. The slightly concave shoulder occupies about half the whorl on the spire. The periphery is noded and fairly prominent, the sides of the whorls nearly vertical. The body was doubtless produced. The spiral directly in front of the suture is not very strong and is obscurely beaded. Between this and the noded periphery are 3 less prominent spirals overridden by the strong growth lines, which outline the retral sinus and are symmetrically disposed on the shoulder. The crenate periphery involves 2 of the 4 or 5 flattened spirals that decorate the sides of the whorl. About 12 similar spirals gird the sides and base of the body. The aperture is narrow, the characters of the inner surface of the outer lip lost, but the pillar plications are well exposed. There are 6 of them, and they are directed at a high angle to the axis of the shell. They tend to be arranged in pairs and to decrease in prominence anteriorly. The imperfect shell is 17 millimeters high and 7.5 millimeters in diameter.

The form and sculpture pattern is similar to that of *Eucheilodon creno-carinata* Heilprin, 1880, but in *Eucheilodon* the axis of the sinus follows the peripheral keel, and the armature of the pillar does not include plications but only a series of denticles along the inner wall of the aperture. Unfortunately only the single specimen has been recovered.

#### Genus *Eucheilodon* Gabb

1860. *Eucheilodon* GABB, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 379.

TYPE, BY MONOTYPY: *Eucheilodon reticulata* Gabb. Wheelock and Caldwell Counties, Texas.

"Allied to *Pleurotoma*; fusiform or scalariform; spire high; mouth linear, canal straight, not emarginate anteriorly, posterior sinus shallow and situated a little distance from the suture. outer lip thin



on the edge and crenate within, inner lip thin and marked by numerous bead-like teeth, seen only in the adult shell; surface marked like *Pleurotoma*.

"*Observation*.—The most prominent character by far is the peculiar arrangement of the inner lip. The markings are not folds encircling the columella as in the well known genus *Voluta*, and in the following genus [*Scobinella*] but a row of minute beads which are found only in the adult individual. I have before me numerous immature specimens which show no trace of these beads or papillae." Gabb, 1860.

*Eucheilodon* sp. cf. *E. creno-carinata* Heilprin

(Plate 27, figure 26)

Heilprin's species (U. S. Nat. Mus., Proc., vol. 3, p. 150, pl. (no number), fig. 4, 1880) was described as follows:

"Whorls subscalariform, flattened above, the angulation formed by a doubly crenulated carina; volutions ornamented by numerous revolving, profoundly elevated striae, which are decussated by the much finer sinuated lines of growth; the upper or flattened portion with a prominent beaded line bordering the suture, and two (a finer and coarser line) intermediate ones between the same and the carina; outer lip grooved within and probably sharply crenulated by the terminations of the revolving striae; columella with about eleven beads, which decrease in size from above downwards. Aperture nearly equal in length to the spire?"

The axis of the retral sinus follows the peripheral keel. The protoconch and the early whorls of the conch are missing, but the long, slender anterior canal is preserved. The specimen measures 22.5 millimeters in height and 9.3 millimeters in diameter. The characteristic features of the aperture are beautifully shown.

The holotype, U. S. Nat. Mus. 8921, is from Jackson, Mississippi.

A very fine new species of *Eucheilodon* is probably represented by a fragment of about 3 whorls from the middle part of the Laredo formation at U.S.G.S. sta. 13643 (M-25). The shoulder ramp is moderately steep, the sides of the whorls vertical, and the peripheral angle is slightly behind the median horizontal of the whorl. The sculpture pattern is elaborate. A prominent noded spiral directly in front of the suture somewhat obscures it; two other moderately strong simple spirals are symmetrical on the shoulder. The 5 or 6 spirals on the sides of the whorls are flattened; the 3 which gird the peripheral area are more closely spaced than the 2 or 3 in front of them and are axially rippled. The axials are close-set, not far from 25 in number, and are overridden by the spirals. An incremental lamination similar to that exhibited by many species of *Pleuroliria* is developed in the interspiral areas. The apertural characters are not preserved. The fragment (U. S. Nat. Mus. 497425) is 9 millimeters high and 5 in diameter.

The reference of this fragment to *Eucheilodon* is made with conviction because of its close similarity to *Eucheilodon creno-carinata* Heilprin, 1880, described from Jackson, Mississippi. The general sculpture pattern is the same in both species, but the noded sutural spiral is rather less prominent in the Mexican species, and in the Jackson form only 2 instead of 3 of the spiral fillets are involved in the axial ribbing.

Family CONIDAE

Genus *Conus* Linnaeus

1758. *Conus* LINNAEUS, Systema Naturae, ed. 10, p. 712.

TYPE, BY SUBSEQUENT DESIGNATION (Children, Quart. Jour. Sci. Lit. Arts, p. 69, Oct., 1823; Lamarck's Genera of shells, p. 1072, 1823): *Conus marmoreus* Linnaeus. Recent in the Indo-Pacific.

Shell heavy, porcellaneous, inversely conical. Spire short or depressed, simple, keeled, rarely tuberculate. Body whorl generally smooth, in large measure embracing the spire. Aperture narrow, with parallel or subparallel margins. Outer lip simple, thin, sharp-edged, notched at the suture. Columella straight, smooth, truncate anteriorly.

The cones, conspicuous for their beauty in form and color pattern, have their roots in the Cretaceous. About 400 recent species have been recognized, most of them along the shores of the tropical seas. In the genotype, the periphery of the shoulder is sharply crenate, a character not observed in any Tertiary species of the Gulf Province.



Subgenus *Leptoconus* Swainson

1840. *Leptoconus* SWAINSON, Treatise on malacology, p. 312.

TYPE, BY SUBSEQUENT DESIGNATION (Herrmannsen, Indicis generum malacozoorum, Primordia, vol. 1, p. 584, May, 1847): *Conus amadis* Martini. Recent in the Indo-Pacific.

Shell of moderate dimensions, rather light in weight. Spire low or moderately low, the early whorls commonly forming a rather prominent medial knob, the shoulders of the later whorls oblique or, in many species, concave and the increase in elevation due to the winding a little in front of the shoulder. Shoulder commonly spirally lirate. Aperture narrow, oblique, the margins parallel as far as the slight constriction of the inner wall at the anterior fasciole. Fasciole faintly lirate, bulging a little, obliquely truncate. Anal fasciole shallow, symmetrical on the shoulder. Outer lip sweeping forward from the shoulder margin in a broad smooth curve, the edge of the lip very thin and sharp. Parietal wall free from wash except at the anterior fasciole where there is a distinct pad and in some individuals an obscure surface fold.

The subgenus is characterized by the forward flare of the outer lip. The edge is so thin that it is broken in most of our fossil specimens, but the contour is clearly indicated by the growth lines. *Leptoconus* is the dominant group among the cones of the Gulf Province during the middle Eocene, and from our meager collections they seem to have been equally prominent relatively in the middle Eocene of the Paris Basin.

*Conus (Leptoconus) smithvillensis* Harris

1895. *Conus smithvillensis* HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 55, pl. 4, fig. 2.

1937. *Conus (Lithoconus) smithvillensis* Harris. PALMER, Bull. Am. Paleontology, vol. 7, no. 32, p. 464, pl. 73, figs. 17, 21.

"General form as figured; whorls about 12; smaller spiral whorls costate or crenulate; penultimate whorl smooth; body whorl smooth, except about 12 revolving lines at base. . . .

"Locality.—Smithville, Bastrop Co., Tex.

"Type.—Texas State Museum." Harris, 1895.

*Conus smithvillensis* differs from *C. santander* in the notably higher spire and more slender and more attenuated body. A peripheral nodding is evident on the early whorls, and there is in addition a nodding of the 3 or 4 moderately strong lirations on the shoulder. In our collections, none of the examples of *C. smithvillensis* exceed 40 millimeters in height, and the species occupies consistently a slightly lower horizon in the lower Claiborne than that in which *Conus santander* is found.

A smallish, high-spined species in the lower Laredo at U.S.G.S. sta. 13596 (H-15) near China, Carlos Cantú, Nuevo León, is commonly represented, but none of the material is well preserved. However, the small size, high spire, and the few remnants of a noded sculpture pattern indicate the Smithville form. Nothing of the sort has been found in the higher horizons.

*Conus (Leptoconus) santander* Gardner, n. sp.

(Plate 26, figures 5, 9, 10, 14)

1931. *Conus sauridens* Conrad. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 100, pl. 6, fig. 6. Not *Conus sauridens* CONRAD, Fossil shells of the Tertiary formations of North America, p. 33, 1833.

1937. *Conus (Lithoconus) sauridens* Conrad (part). PALMER, Bull. Am. Paleontology, vol. 7, no. 32, pp. 458–459.

Shell rather heavy, porcellaneous, the spire low and the sides converging at an angle of 45° or less. Nuclear turns small, high, smooth, and polished, 3 or 2 and a fraction in number. The 4 or 5 succeeding turns closely noded, the nodes on the earliest postnuclear turns medial but pushed forward with the development of the shoulder and gradually dying out. Suture following close on the shoulder on the adolescent whorls but inclined to drop farther and farther forward in the adult and gerontic forms. Spiral sculpture restricted to half a dozen or fewer not very regular spirals on the shoulder and a faint irregular lineation toward the base of the body. Aperture as wide as the shoulder, oblique to the axis of the shell, the margins parallel as far as the anterior fasciole. Anal fasciolar notch shallow as indicated by the feebly arcuate growth lines. Outer lip thin, sharp, flaring widely,



the maximum expansion falling about midway between the shoulder and the anterior fasciole. Parietal wall simple and free from callus as far as the anterior fasciole where it flattens slightly and develops, in the adult, a small but heavy callus pad. Fasciole defined by the spiral liration and the change in direction of the growth lines rather than by the contour of the shell; obliquely truncate at the extremity.

**DIMENSIONS OF HOLOTYPE:** Height, 48 millimeters; diameter, 27.5 millimeters; length of aperture, 42 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 495181.

**TYPE LOCALITY:** U.S.G.S. sta. 4786, Moseleys Ferry, Brazos River opposite Stone City post office, Burleson County, Texas.

An incomplete specimen is also figured (U. S. Nat. Mus. 496034) from the lower Laredo at U.S.G.S. sta. 13967 (J-20).

*Conus santander* includes those species from the western Gulf that have formerly been included under *Conus sauridens* Conrad, described from Claiborne. Our material from Claiborne is meager, and the species is without doubt rare, for in one very large collection from the so-called Claiborne sand there is not a single example of *C. sauridens*. A few fragments but no complete individuals were taken at Lisbon. In the older Museum collections there are a few specimens which from their preservation seem to be from the "Claiborne sand" rather than the Lisbon. These individuals show a more regular outline than the Laredo species, and there is a distinct plication on the callus at the base of the body. This is not developed in the adolescent forms, but the margin of the pillar is twisted slightly. The nuclear whorls are more inflated in the Alabama species than in that from the western Gulf, and a spiral grooving is developed on the body of the young which has not been noted in *C. santander*. *Conus santander* offers a rather wide range of variation in the relative height and diameter and in the winding of the shell. The terracing of the spire is not so marked, however, as it is in the later *Conus highti*, nor is the change from an almost horizontal to a terraced spire so abrupt. *Conus santander* is widespread in the western Gulf, in that area which was formerly included in the Nuevo Santander of the days of the Spanish occupation. In Texas, its abundance at Moseleys Ferry and in the Arroyo Chacon near Laredo is notable. It has been recognized only in the Cook Mountain and the Laredo formations. The relationship to *Conus highti* of the later Claiborne of the Rio Grande Embayment and to *Conus tortilus* Conrad of the Jackson of both the eastern and western Gulf is probably genetic.

**DISTRIBUTION:** Laredo formation: lower Laredo, U.S.G.S. sta. 13558 (H-12); U.S.G.S. sta. 13562 (H-12); U.S.G.S. sta. 13560 (H-12); U.S.G.S. sta. 13564 (H-12); U.S.G.S. sta. 13563 (H-12); U.S.G.S. sta. 13454 (H-15); U.S.G.S. sta. 13595 (H-15); U.S.G.S. sta. 13601 (H-16); U.S.G.S. sta. 13969 (I-19); U.S.G.S. sta. 13970 (I-19); U.S.G.S. sta. 13971 (I-20); U.S.G.S. sta. 14063 (J-19); U.S.G.S. sta. 13967 (J-20); Middle Laredo, U.S.G.S. sta. 13790 (G-4).

*Conus (Leptoconus) highti* Gardner, n. sp.

(Plate 26, figures 2, 7)

Shell rather large and heavy for the subgenus, probably as many as 15 whorls in the fully adult. Early whorls coiled in a plane that is nearly horizontal, the later whorls terraced so that in the holotype the aperture is about four fifths of the length of the shell. Sides of body converging at an angle between 35° and 40°. Protoconch not preserved in any of the available material. Earliest conchal turns high, increasing slowly in diameter and forming with the protoconch a small knob in the middle of the adolescent whorls, which are coiled in nearly a single plane. Change in the plane of coiling rather abrupt, the suture dropping in front of the narrow shoulder and giving to the spire a turreted contour. Spiral sculpture confined to a few rather feeble and irregular lirations on the shoulder, least feeble directly behind the slightly raised outer rim. Aperture oblique to the axis, narrow; the margins parallel as far as the anterior fasciole. Growth lines strongly retractive on the shoulder, bending sharply directly behind the periphery; in front of the periphery, strongly protractive. Outer lip thin, sharp, widely flaring. Inner wall apparently free from wash. Characters of anterior extremity obscured by the matrix. Anterior fasciole bulging slightly and corrugated by the heavy growth lines. No visible inner pad of callus, such as that developed in *Conus santander*; possibly concealed by matrix.



**DIMENSIONS OF HOLOTYPE:** Height, 60 millimeters; greatest diameter, 31.5 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 495182; incomplete paratype, U. S. Nat. Mus. 495183; figured specimen, U. S. Nat. Mus. 496037. Middle part of the Laredo formation.

**TYPE LOCALITIES:** Holotype, U.S.G.S. sta. 13168, Arroyo Veleño, below highway bridge on Zapata-Roma road, Zapata County, Texas; incomplete paratype, U.S.G.S. sta. 13984 (H-6); figured specimen, U.S.G.S. sta. 13565 (H-12).

*Conus highti* when adult and fairly well preserved is readily separable from the earlier *Conus santander*. The spire is higher and more unevenly coiled. In the adolescent, the suture follows the almost horizontal shoulder so that the visible portion forms a disk with a central knob of the nuclear and earliest postnuclear whorls, and together they top the later turreted whorls like a coolie hat. The greater number of the individuals are known only from the worn posterior half of the shell, and the characters of the anterior extremity are to a certain degree conjectural. The paratype is typical of the common state of preservation. *Conus highti* seems to occupy a horizon slightly higher than that in which *Conus santander* is abundant.

The species is named in honor of Harold W. Hight to whom we owe many of our most valuable collections.

**DISTRIBUTION:** Laredo formation: middle Laredo, U.S.G.S. sta. 13984 (H-6); U.S.G.S. sta. 13800 (H-9); U.S.G.S. sta. 13685 (H-9); ?U.S.G.S. sta. 13567 (H-11); U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13570 (H-12); U.S.G.S. sta. 13590 (I-13); U.S.G.S. sta. 13594 (H-13); U.S.G.S. sta. 13591 (H-13); U.S.G.S. sta. 13555 (H-14); U.S.G.S. sta. 13547 (I-14); U.S.G.S. sta. 13554 (I-14); U.S.G.S. sta. 13553 (H-15); U.S.G.S. sta. 13551 (H-15); U.S.G.S. sta. 13643 (M-25).

*Conus (Leptoconus) sp.*

(Plate 26, figure 12)

A few cones in the Laredo formation of northeastern Mexico seem to represent a species distinct from any described. They are imperfectly preserved or show signs of immaturity. In both *Conus santander* and *C. highti* the shoulders of the adolescent whorls are horizontal or slightly concave. In the forms in question the sides of the spire, except for the indented sutures, are evenly sloping and converge at an angle of about 90°. The character of the spiral lineation and of the incrementals and the flare of the outer lip are similar to that of the other Claiborne species. The sloping shoulder gives a different aspect to the posterior end of the aperture, but the anterior extremity of the shell and the fasciole are similar in all recorded details to that of *Conus santander*. The individual figured (U. S. Nat. Mus. 496035) is 27 millimeters high and 15 millimeters in diameter. Possibly it is not fully grown, although there are no obvious indications of immaturity.

The species is known only from the middle Laredo at U.S.G.S. sta. 13567 (H-11), Nuevo León.

*Conus (Leptoconus) tortilis* Conrad

(Plate 26, figures 1, 4, 6, 8, 13)

- 1854. *Conus tortilis* CONRAD, in WAILES, Rept. agriculture and geology Mississippi, p. 289 (name only), pl. 15, fig. 5.
- 1855. *Conus tortilis* CONRAD, Acad. Nat. Sci. Philadelphia, Proc., 1st ser., vol. 7, pp. 257, 260.
- 1937. *Conus (Lithoconus) sauridens* Conrad (part). PALMER, Bull. Am. Paleontology, vol. 7, no. 32, pp. 458-459.

"Ovato-turbinata; spire obtusely conical with the apex exerted, acute; whorls obliquely flattened, with revolving impressed lines and transverse wrinkles, carinated near the base, direct between the carina and suture; lines of growth on body whorl profoundly curved; base with a profound thick fold." Conrad, 1855.

**TYPE LOCALITY:** "Green-sand marl bed of Jackson, Miss."

**HOLOTYPE:** Acad. Nat. Sci. Philadelphia 13196.

A very fine specimen in our collections from Montgomery, Louisiana, is 90 millimeters high and 50 millimeters in diameter. The height of the spire is only about one ninth the total height of the shell. There are at least 15 whorls, the first 2½ or 3 included in the small but high smooth polished protoconch. The next few whorls are crenulated at the shoulder, and the succeeding whorls are rimmed with a smooth and somewhat polished and slightly raised margin. Between the rim and the suture, the shoulder is closely lirata, and the lirae are reticulated by feebly arcuate incrementals. The



periphery of the body of the adult is subacute, the sides evenly converging to the truncate anterior extremity. The aperture is narrow, only the width of the shoulder, and the sides subparallel. The shoulder notch is very shallow, the flare of the outer lip pronounced. There is a pad of callus on the inner wall at the anterior fasciole, and behind it a slight depression. The fasciole shows a scarcely perceptible bulge and is feebly lirated.

Although the adults of *Conus tortilis* are readily separable from *C. santander* and *C. sauridens* of the Claiborne, the earlier rating of *C. tortilis* as a subspecies of *sauridens* of authors is understandable. The restricted *C. sauridens* from the eastern and *C. highti* from the western Gulf of Mexico have higher spires than *C. tortilis*, but the Jackson species seems little more than a greater *C. santander* with a slightly lower spire and increased girth. The characters of the earlier whorls, the few sculpture details, the flare of the outer lip, and the flattened and callused anterior extremity of the columella are similar in both.

FIGURED SPECIMENS: U. S. Nat. Mus. 497097 and 497098 from U.S.G.S. sta. 13598 (L-11), at Presa El Mescal, Zacate, General Bravo, Nuevo León; U. S. Nat. Mus. 497099 from U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7° 30' E. of Ciudad Camargo, Tamaulipas; and U. S. Nat. Mus. 494949 from U.S.G.S. sta. 13506 (M-7), 13.5 kilometers S. 12° E. of Ciudad Camargo, Tamaulipas, Mexico.

DISTRIBUTION: Jackson formation: lower or middle Jackson, U.S.G.S. sta. 13506 (M-7); U.S.G.S. sta. 13504 (M-8). Upper Jackson, U.S.G.S. sta. 13598 (L-11); U.S.G.S. sta. 14009 (M-13).

### *Conus (Leptoconus) alveatus* Conrad

(Plate 26, figures 3, 11)

1865. *Conus alveatus* CONRAD, Am. Jour. Conchology, vol. 1, pp. 30, 148, pl. 11, fig. 4.

1922. *Conus alveatus* Conrad. COOKE, U. S. Geol. Survey, Prof. Paper 129-E, pp. 81, 83.

"Oblong-turbinate, thin in substance; sides straight below and slightly convex above; summit of body volution and each whorl of the spire profoundly carinated; spire very short, with a slightly concave outline; base with impressed revolving lines.

"*Locality*.—Vicksburg, Miss.

"This species differs from the Eocene *sauridens*, in having a less elevated and a more profoundly carinated spire, and the revolving lines on the spire are less numerous in the former." Conrad, 1865.

Cooke reports the species from the Red Bluff to the Byram marl. The specimens from Nuevo León approach the topotypes closely. The figured individual (U. S. Nat. Mus. 496036 from U.S.G.S. sta. 13539) probably measured about 30 millimeters in height and a little more than half that in diameter. The spire is a low, graceful cone, serrate at the suture line, which follows a little in advance of the shoulder. The protoconch is not preserved, but the early whorls as in other leptocones increase slowly in diameter and form a small, high knob in the middle of the low spire. The nodding of the early whorls is retained through the adolescent stages but is pushed forward to the periphery of the shoulder which it crenulates. The shoulder lirae, commonly 4, are more even and more evenly spaced than in the related Eocene species and are cancellated by the arcuate incrementals. The flare of the outer lip is not so pronounced as that of the Claiborne species.

*Conus alveatus* seems more closely related to *C. santander* and *C. sauridens* of the Claiborne than to *C. tortilis* of the Jackson.

DISTRIBUTION: Middle Oligocene sandstone: U.S.G.S. sta. 14144 (P-22); ashy bed at base of upper middle Oligocene sandstone: U.S.G.S. sta. 13539 (N-17).

### *Conus (Leptoconus?) protractus* Meyer

(Plate 10, figure ?22)

1885. *Conus protracta* MEYER, Am. Jour. Sci., 3d ser., vol. 29, pp. 466, 468.

1886. *Conus protractus* MEYER, Geol. Survey Alabama, Bull. 1, p. 75, pl. 2, fig. 7.

1922. *Conus protractus* Meyer. COOKE, U. S. Geol. Survey, Prof. Paper 129-E, p. 83.

"In Vicksburg occurs a new species, *Conus protracta*. It approaches in its form the genus *Conorbis*. The lower part is almost like that of *Conus sauridens* C., but it is a smaller species. The spire is elevated, forming the third part of the shell, is without revolving lines and has one or two smooth embryonic whorls more than *C. sauridens*." Meyer, 1885.

Two imperfect specimens from the lower Oligocene of Zacate have been referred to Meyer's species. An incomplete cone, U. S. Nat. Mus. 497096 from U.S.G.S. sta. 13505 (N-8), has been figured. Like



the form from Mississippi, it is a small, biconic shell, 15–20 millimeters high and including, perhaps, half a dozen whorls in the conch. The suture falls in front of the crenate periphery. The shoulder ramp is fairly steep and sculptured only with faint growth lines which indicate a deep retral sinus. The forward flare of the outer lip was probably not pronounced. The nuclear characters have not been retained. Meyer records the species both from Red Bluff and from Vicksburg, but in our collections from the Gulf province it is present only in the Byram marl.

DISTRIBUTION: Lower marine Oligocene sandstone: ?U.S.G.S. sta. 13505 (N-8); ?U.S.G.S. sta. 14056 (M-12).

### *Conus* sp.

The few Miocene cones are represented by internal molds only and are not specifically determinable. They show, however, the short, broad outline characteristic of the group that was widespread in the mid-Americas in the mid-Miocene. The sculptured cones of the Shoal River formation of Florida have a similar outline.

## Family TEREBRIDAE

### Genus *Terebra* Bruguière

1789. *Terebra* BRUGUIÈRE, Encyclopédie méthodique, Histoire naturelle des vers, vol. 1, p. XV (no species mentioned).  
 1799. *Terebra* LAMARCK, Prodrome d'une nouvelle classification des coquilles, Soc. hist. nat. Paris, Mém., p. 71. Sole example, *Buccinum subulatum* Linnaeus.  
 1908. *Terebra* Bruguière. DALL, Mus. Comp. Zoology, Harvard College, Bull., vol. 43, no. 6, p. 245.  
 1923. *Terebra* (Bruguière) Lamarck. BARTSCH, Nautilus, vol. 37, pp. 60–64.  
 1928. *Terebra* Bruguière. WOODRING, Carnegie Inst. Washington, Pub. 385, p. 135.

TYPE, BY MONOTYPY [Lamarck]: *Buccinum subulatum* Linnaeus. Recent in the Indo-Pacific.

The conch is slender, turreted, acuminate, and polygyrate. The external surface is smooth or sculptured axially, reticulately, or more rarely spirally. The most conspicuous feature of the ornamentation is commonly a deep sulcus revolving at a short distance in front of the suture and parallel to it. The aperture is ovate or quadrate and terminates anteriorly in a short recurved canal.

*Terebra* is abundantly represented throughout the Cenozoic; the Recent species are widely distributed, though most prolific in the inshore waters of the warm temperate and tropical seas.

### Subgenus *Strioterebrum* Sacco

1891. *Strioterebrum* SACCO, Molluschi dei terreni terziarii del Piemonte e della Liguria, pt. 10, p. 33.

TYPE, BY ORIGINAL DESIGNATION: *Terebra basteroti* Nyst. Miocene of the Piedmont of Italy.

"Testa turrita. Anfractus longitudinaliter costulati, transversim striolati, sulco transverso subsuturale (sat profundo) ornati." Sacco, 1891.

*Strioterebrum* includes the slender, usually small, and reticulately sculptured species with well-marked sutural bands. The aperture in the group is narrow and terminates in a narrow recurved canal, emarginate at its extremity. The siphonal fasciole is clearly defined, and the parietal wall is commonly washed with a thin callus. Vestiges of two columellar folds are usually present, the posterior commonly indicated by a swelling on the pillar rather than by a defined plication.

### *Terebra* (*Strioterebrum*) *tantula* Conrad

(Plate 27, figures ?1, ?14)

- Jan. 1848. *Terebra tantula* CONRAD, Acad. Nat. Sci. Philadelphia, Proc. for 1847, vol. 3, p. 283.  
 Aug. 1848. *Terebra tantula* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 1, p. 114, pl. 11, fig. 15.  
 1937. *T[erebra]. tantula* Conrad. PALMER, Bull. Am. Paleontology, vol. 7, no. 32, p. 468.

"Subulate with longitudinal ribs dislocated by an impressed line; whorls with minute revolving lines.

"Very similar to the preceding [*Terebra divisurum*], but narrower, far less in size, and distinguished by the revolving lines and by the ribs on the body whorl, which extend to the beak. Length 2/3. Rare." Conrad, 1848.



**DIMENSIONS:** Height of larger specimen, 14.5 millimeters; diameter, 4.7 millimeters. Height of smaller specimen, 9.9 millimeters; diameter, 2.8 millimeters.

**FIGURED SPECIMENS:** U. S. Nat. Mus. 497261 from U.S.G.S. sta. 13518 (N-10). Lower marine Oligocene sandstone.

The protoconch of the type in the Academy of Natural Sciences in Philadelphia is small, smooth, acutely tapering, and includes about 4 whorls. The opening of the conch is marked by a break in the texture of the shell and the abrupt beginning of the axial sculpture. The adult whorls are fluted with about 24 well-formed ribs with narrow obtuse crests. The spirals are fine and faint, about 12 to the whorl including the 3 on the sutural band. The spiral groove isolating the band nicks the axials. The body is abruptly constricted at the base. The posterior margin of the anterior fasciole is sharply elevated, and the fasciole is laminated by the incrementals. The slightly twisted edge of the pillar forms the anterior margin of the fasciole and the anterior extremity of the obscure marginal fold. The terminal notch is symmetrical and moderately deep.

In the eastern Gulf region, *Terebra tantula* is reported from the Red Bluff through the Byram marl. It is probably an early member of the group which includes *protexa* Conrad of the Recent southeast coast and Gulf faunas. The Recent species is less slender than that from the Oligocene, and the whorls on the protoconch are fewer.

Forms similar to *T. tantula* have been recovered from the upper Jackson at U.S.G.S. sta. 13513 (M-11). They are not, however, sufficiently well preserved to establish the occurrence of this characteristically Oligocene species at the lower horizon. The presence of the form in the Oligocene of Mexico is questioned only because of the imperfect material.

**DISTRIBUTION:** Lower marine Oligocene sandstone: ?U.S.G.S. sta. 13505 (N-8); ?U.S.G.S. sta. 13518 (N-10); ?U.S.G.S. sta. 13509 (M-11); ?U.S.G.S. sta. 13510 (M-11); ashy bed at base of upper Middle Oligocene sandstone: ?U.S.G.S. sta. 14023 (N-13).

#### Section *Terebrella* Palmer

1937. *Terebrella* PALMER, Bull. Am. Paleontology, vol. 7, p. 466.

**TYPE, BY ORIGINAL DESIGNATION:** *Terebra mirula* DeGregorio = *Terebra texagyra* Harris. Lower Claiborne of the Gulf.

"Shell medium-sized; slender; nucleus of three and a half or four smooth whorls; aperture ovate, elongate below; canal extended, twisted without a shortened notch; the columella is twisted but there is no distinct fold; sculpture discrepant in young and adult; the axial sculpture is well developed in the young and immature, becoming obsolete in the adult; the subsutural band is absent or with only a slight indication in the young while in the adult it is well developed.

"This group is like *Hastula* in that the young is without a subsutural band and has axial ribbing. In *Hastula* the subsutural band does not develop in the adult and the axial ribbing of the young is persistent. *Hastula* has no canal. The anterior portion of the aperture has a deep notch while in *Terebrella* a canal exists.

"*Terebrella* is like *Subula* in that axial ribbing occurs in the young but does not persist in the adult stage. *Subula* has the subsutural band in the young as well as in the adult while in *Terebrella* it occurs only on the older shells." Palmer, 1937.

The differences between *Terebrella* and the small, canaliculate, reticulately sculptured *Strioterebrum* seem on the whole less important than the differences which separate it from *Hastula*, and certainly less than those that separate it from the large Indo-Pacific shell which is the type of *Subula*.

#### *Terebra* (*Strioterebrum*) sp. cf. *T. (S.) texagyra* Harris

(Plate 27, figures 9, 25)

Synonymy and description of *Terebra* (*Strioterebrum*) *texagyra* Harris:

1895. *Terebra texagyra* HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 54, pl. 3, fig. 10.

1931. *Terebra texagyra* Harris. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 100.

1937. *Terebra* (*Terebrella*) *mirula* De Gregorio. PALMER, Bull. Am. Paleontology, vol. 7, p. 467 (part), pl. 72, figs. 8, 10, 11, 16-18. Not *Terebra mirula* DE GREGORIO, 1890.

"General form and size as indicated by the figure; whorls about 15; marked as follows: slightly shouldered below the suture; below two-sevenths of the way to the next suture with a moderately strong spiral stria; ribs about 15 on each whorl, strong above but dying out below, not deflected or dislocated by the subsutural revolving line; columella twisted as shown in the figure.



"Conrad's *T. polygyra* has a more slender form, with far less prominent plicae. *T. divisurum* and *T. polygyra* both show dislocation at the subsutural line. *T. texagya* resembles *T. tantula* in some respects, but is less costate and less slender.

"Localities.—Between Orrell's and Evergreen Crossing, on Elm Creek, Lee Co.; near Crockett and 2 miles west of Crockett, Houston Co.

"This is doubtless, in part at least, the species referred to by Aldrich and Meyer as '*T. divisura* Con., var.' They give as localities, Claiborne and Lisbon, Ala.; Wautubbee and Newton, Miss.; Wheelock, Tex.

"Geological horizon.—Lower Claiborne Eocene.

"Type.—Texas State Museum." Harris, 1895.

The species figured should probably not be included in *Terebra texagya* s. s. Figure 9 of Plate 27 which illustrates the adolescent shell is more strongly sculptured than the immature shells from other sections of the western Gulf, and the apical angle is higher. Figure 25 (Plate 27) represents an adult of the same species, and although it is larger than any example in our collections it does not exceed the dimensions indicated in the type. We have no complete specimens from northeastern Mexico and none on which the protoconch is preserved.

*Terebra houstonia*, more widespread than *T. texagya* both geographically and stratigraphically, differs in the relatively higher whorls, the more strongly defined sutural band, the bulge of the anterior half of the adult whorl, and the absence of a twist to the pillar.

DIMENSIONS: Height of incomplete spire, 11.6 millimeters; greatest diameter, 3.7 millimeters. Height of final 3 to 4 whorls, 14.6 millimeters; diameter of body whorl, 5.0 millimeters.

Incomplete spire: U. S. Nat. Mus. 497442 from U.S.G.S. sta. 13861 (H-4). Final 3 to 4 whorls: U. S. Nat. Mus. 497441 from U.S.G.S. sta. 13565 (H-12).

Palmer has united the lower Claiborne *texagya* with De Gregorio's *T. mirula*, from the Gosport sand, but the upper Claiborne species is decidedly larger and less slender, and the ribbing on the early whorls is more crowded. In growth habit and sculpture pattern, *T. mirula* suggests an ancestral form of *T. inequalis* Sowerby from the Miocene of the mid-Americas.

DISTRIBUTION OF *Terebra* (*Strioterebrum*) sp. cf. *T. (S.) texagya* HARRIS: Laredo formation: middle Laredo, U.S.G.S. sta. 13861 (H-4); U.S.G.S. sta. 13984 (H-6); U.S.G.S. sta. 13567 (H-11); U.S.G.S. sta. 13565 (H-12); U.S.G.S. sta. 13569 (H-12); U.S.G.S. sta. 13591 (H-13); U.S.G.S. sta. 13554 (I-14).

### *Terebra* (*Strioterebrum*) sp.

A mold of the exterior of a *Strioterebrum* suggesting, in the strength of the reticulate sculpture, *T. gatunensis* Toula (K.k. geol. Reichsanstalt Jahrb., Band 58, Heft 4, p. 705, pl. 25, fig. 14, 1908) was recovered from the yellow limestone of the Guajalote formation at U.S.G.S. sta. 13587 (W-30), 3250 meters south of the church tower at San Fernando, Tamaulipas. Though not determinable, it is a fragment undoubtedly of one of a group of closely related species abundant in the middle and upper Miocene of the mid-Americas.

### Genus *Hastula* H. and A. Adams

1853. *Hastula* H. AND A. ADAMS, Genera of Recent Mollusca, vol. 1, p. 225.

TYPE, BY SUBSEQUENT DESIGNATION (Cossmann, Essais paléoconchologie comp., vol. 2, p. 53, 1896): *Buccinum strigilatum* Linnaeus. Recent in the Indo-Pacific.

Shell of moderate dimensions and moderately slender for the genus. Spire evenly tapering. Whorls closely appressed, the sutures distinct but not conspicuous. Protoconch small, smooth, containing in the genotype between 2 and 3 volutions. Sculpture restricted to numerous narrow, more or less wavy axials commonly restricted to the posterior portion of the whorl and, in the genotype, becoming stronger on the later whorls. No spiral sculpture developed, not even a prosutural band. Aperture wedge-shaped. Outer lip descending vertically, rounding broadly into the terminal notch. Inner wall of aperture only feebly constricted at the base of the body, narrowly glazed. Margin of the very short pillar compressed but no true fold evident at the mouth. Terminal notch broadly U-shaped.

*Hastula* is widely though not abundantly distributed throughout the warm seas. The Gulf Eocene species are not typical, but they seem to be closer to *Hastula* than to any other established group. In addition to *Hastula? houstonia* (Harris), described from the lower Claiborne of Texas, representatives of small species possibly referable to *Hastula* were found in beds of lower or middle Jackson age.



at U.S.G.S. sta. 13503 (N-8), 20.8 kilometers S. 12° 30' E. of Ciudad Camargo; and at U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7° 30' E. of Ciudad Camargo, Tamaulipas.

*Hastula? houstonia* (Harris)

1895. *Terebra houstonia* HARRIS, Acad. Nat. Sci. Philadelphia, Proc., p. 55, pl. 3, fig. 11 (Pl. 4, fig. 1 excluded).  
 1896. *Terebra houstonia* Harris. VAUGHAN, U. S. Geol. Survey, Bull. 142, p. 38.  
 1931. *Terebra houstonia* Harris. RENICK AND STENZEL, Univ. Texas Bull. 3101, p. 100.

"Size and general form as indicated in the figure; whorls 12 or 13, longitudinally ribbed, the ribbing being much coarser in the upper part of the shell than in the lower; suture margined below by an obscurely impressed revolving line; columella straight, smooth, tapering rapidly.

"This species is characterized at once by the height of its whorls in comparison to their respective diameters, the bulging sides of the whorls, the irregularities of the ribbing, and the straight, smooth columella. . . .

"Geological horizon.—Lower Claiborne Eocene.

"Type.—Texas State Museum." Harris, 1895.

Harris' species from the western Gulf region develops no sutural band, but some of the individuals are faintly lineated, and a feeble striation at the base of the body is usual. Closely related forms described from Smithville, but not represented in our collections made south of the Rio Grande, are characterized by a very fine intercostal lineation. In other forms, also closely allied, the axials directly in front of the suture are noded, thus simulating a sutural band. In *H.? houstonia*, the axials become increasingly less prominent toward the aperture, but in the genotype it is the later volutions and not the earlier which are the more strongly costate. *H.? houstonia* has much in common, however, with *Terebra plicatula* Lamarck, from the Lutetian of the Paris Basin, referred by Cossmann to the genus *Hastula*.

The first record of the family is from the Upper Cretaceous, and possibly in the middle Eocene the overlap of the group was greater than in the Recent faunas.

In Mexico, *Hastula ? houstonia* has been doubtfully recognized only from the vicinity of Mier; in the middle part of the Laredo formation at U.S.G.S. sta. 13772 (G-3); and from the upper Laredo at U.S.G.S. sta. 13935 (H-3).

*Incertae sedis*

Slender, cuneate shells rarely more than 6 millimeters high are fairly common in concretionary sandstone at U.S.G.S. sta. 13682 (F-8). There are about 5 whorls in the conch, and possibly as many more in the large protoconch. The first 2 minute nuclear whorls may be smooth. They are succeeded by relatively wide, feebly inflated whorls crowded with sharp, nearly vertical axials, probably 20 to 25 to the whorl. The later turns are rather wide, straight-sided, increasing very slowly in diameter, and sculptured with about 12 feebly arcuate, pinched axial ribs, strengthening slightly toward the anterior suture and flattening a little in front of the posterior; evanescent on the base of the body. Possibly 4 or 5 equal and equispaced obscure spiral lirae are faintly visible on the sides of the whorl, and less feeble lirae gird the base. The body rounds smoothly into the anterior extremity. The axials die out, and a spiral sculpture is visible. The characters of the anterior extremity and of the aperture are not known.

These small shells vaguely recall *Hastula ? houstonia* (Harris) of the lower Claiborne fauna of the western Gulf region.

Subclass EUTHYNEURA

Order OPISTHOBRANCHIA

Suborder TECTIBRANCHIA

Family ACTEONIDAE

*Incertae sedis*

Fragmentary impressions of acteonid sculpture are not uncommon in the lower or middle Jackson at U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7° 30' E. of Ciudad Camargo, Tamaulipas. The



pattern suggests that of "*Actaeon*" *annectens* Meyer, but the associated molds indicate a more slender species with the spire almost as high as the body.

Genus *Tornatellaea* Conrad

1860. *Tornatellaea* CONRAD, Acad. Nat. Sci. Philadelphia, Jour., 2d ser., vol. 4, p. 294.

TYPE, BY MONOTYPY: *Tornatellaea bella* Conrad. Lower Eocene of the Gulf.

"Ovate ventricose; columella with two slender, prominent folds, the lower fold not distinctly continuous with the margin of the base." Conrad, 1860.

The genus shares with *Acteon* a heterostrophous nucleus and a dominantly spiral, often punctate sculpture. The shell is characteristically heavier, however, the labrum is lirate within, the columella bears 2 folds instead of 1, and the anterior extremity of the aperture is constricted into an incipient canal.

According to the later citations, the genus is restricted in its distribution both in the Eastern and Western hemispheres to the earlier Tertiary formations. Neither the records from the Mesozoic nor from the Miocene of the Bordelais have been verified.

*Tornatellaea cerralvensis* Gardner, n. sp.

(Plate 12, figure 3)

Shell very small and squat, the spire of probably 4 or 5 whorls, the extreme tip broken away in all determinable material. Body relatively broad and evenly inflated. Nuclear whorls lost. Entire surface of conch spirally grooved, the grooves squarely channeled, regular in size and spacing, and slightly wider than the angular areas that separate them; about 6 to the final whorl of the spire and three or four times that number on the body. Aperture narrow, lobate, the columella biplicate.

DIMENSIONS OF HOLOTYPE: Height, 5 millimeters; maximum diameter, 3.5 millimeters.

HOLOTYPE: U. S. Nat. Mus. 494969.

TYPE LOCALITY: U.S.G.S. sta. 13463 (B-9): 7600 meters east of old church at Cerralvo, Nuevo León. Lower part of Midway formation.

*Tornatellaea cerralvensis* differs from the other *Tornatellaeas* of the Gulf chiefly in the smaller size and relatively lower spire and broader body. It is rather abundant at the few Midway localities from which collections have been made.

DISTRIBUTION: Midway formation: lower Midway, U.S.G.S. sta. 13473 (B-6); U.S.G.S. sta. 13464 (B-9); U.S.G.S. sta. 13463 (B-9).

Genus *Nucleopsis* Conrad

1865. *Nucleopsis* CONRAD, Am. Jour. Conchology, vol. 1, p. 34.

1894. *Nucleopsis* CONRAD. COSSMANN, Annales géologie paléontologie, vol. 12, p. 48 of separate.

1895. *Nucleopsis* CONRAD. COSSMANN, Essais paléonconchologie comp., vol. 1, p. 56.

TYPE: BY SUBSEQUENT DESIGNATION (Cossmann, Annales géologie paléontologie, vol. 12, p. 48' 1894), *Actaeonina subvaricata* Conrad. Claiborne group of the Gulf Province.

Conrad did not describe his subgenus, but he listed under *Acteon*, subgenus *Nucleopsis*, three species, *Actaeon costellatus* Conrad, *Actaeon latus* Conrad, and *Actaeon subvaricatus* Conrad described as *Actaeonina*. *Actaeon costellatus* was briefly described and never figured, and the figure of *Actaeon latus* is but little better than none at all. Neither of the species has been recognized in later collections. The third, *Actaeonina subvaricata*, designated as the type by Cossmann, is a rather rare but exceptionally well characterized form, described, like the two other species, from the Claiborne group and excellently figured by Cossmann (1894). The general description is based upon it.

Shell small, solid, squat, ovate in outline. Greatest diameter submedial. Protoconch small, smooth, acutely tapering, including not far from 3 volutions, the initial turn heterostrophous. Whorls of spire narrow, trapezoidal, increasing rapidly in diameter, possibly 5 or 6 in number. Body smoothly rounded, tapering anteriorly but with no suggestion of a canal. Entire conch girded with low flattened lirae inclined to be irregular; axial sculpture manifested only by faint incrementals and an occasional subvaricose resting stage. Aperture narrow, auriculate, slightly patulous and scoop-shaped anteriorly. Outer lip reinforced along the inner margin. Parietal wall very thin, thicken-



ing along the pillar and continuous with the lining of the labrum. A single oblique and obscure fold on the pillar at the base of the body. No trace of an umbilical opening.

Both the conch and the protoconch of *Nucleopsis* differ from those of *Acteon*. The protoconch is smaller and more acutely tapering, although the initial whorl, like that of *Acteon*, is heterostrophic. The body is rounded off at the base, and there is no incipient anterior canal and no umbilical chink or depression. The outer lip is thickened within. The pillar fold is barely perceptible. The sculpture does not exhibit the sharpness and incision of the family, but the spirals are flattened and more or less irregular, and the grooves are not punctated by the incrementals. The relationships of *Nucleopsis* are not clearly defined. It fails to present some of the characteristic features of the Acteonidae, but I know of no group with which it is more closely affiliated.

*Nucleopsis* sp.

(Plate 16, figures 9, 10)

A single minute and not very well preserved specimen (U. S. Nat. Mus. 497440) from the upper part of the Jackson formation at U.S.G.S. sta. 13513 (M-11), Zacate, Nuevo León, has retained the characteristic features of the genus.

The height of the figured specimen is 2.6 millimeters, the diameter, 1.7 millimeters.

Family RINGICULIDAE

Genus *Ringicula* Deshayes

1838. *Ringicula* Deshayes, LAMARCK, Histoire naturelle des animaux sans vertèbres, 2d ed., vol. 8, p. 342.

TYPE, BY SUBSEQUENT DESIGNATION: (Anton, Verzeichniss der Conchylien, p. 48, 1839): *Ringicula auriculata* Deshayes = *Auricula ringens* Lamarck. Eocene of the Paris Basin.

Shell small, squat, spire relatively short, the body ovate. Nucleus heterostrophous. Surface of shell smooth or spirally striate. Aperture narrow, parallel to the axis of the shell, dilated and more or less emarginate anteriorly. Outer lip thickened and reflected, smooth or finely plicate within. Columella excavated, callused, furnished posteriorly with a strong tubercular denticle and anteriorly with two prominent, transverse plaits.

The genus has been noted in the Cretaceous deposits of Europe and India as well as in those of North America. Some 70 species are reported from the various Tertiary horizons, and about 35 from the temperate and tropical waters of today. Most of the Recent members of the genus occur in waters over 50 fathoms in depth.

*Ringicula* sp.

Molds from the lower Midway limestone in Cuevas Ridge, 4 kilometers northwest of Juarez, U.S.G.S. sta. 13460 (B-7), and from 7 kilometers east of the old church in Cerralvo, U.S.G.S. sta. 13464 (B-9), show the characteristic ovate-trigonal outline, spiral grooving, and thickened outer lip of *Ringicula* but are not specifically determinable.

*Ringicula* sp.

Two individuals of a minute and very slender *Ringicula* were recovered from the upper Oligocene limestone at U.S.G.S. sta. 13579 (P-25), 5 kilometers N. 21° W. of Mendez. Except for their dimensions—the largest is only 1.5 millimeters high and less than 1 millimeter broad—they are apparently typical adult *Ringicula*. The sculpture, a very fine spiral lineation, is developed over the entire body, and the outer lip is reinforced by a broad band of callus. No described species is comparable to these lilliputian forms.

Family ACTEOCINIDAE

Genus *Acteocina* Gray

1847. *Acteocina* GRAY, Zool. Soc. London, Proc., pt. 15, p. 160.  
= *Tornatina* ARTHUR ADAMS in SOWERBY, Thesaurus conchyliorum, pt. 11, p. 554, 1850.

TYPE, BY ORIGINAL DESIGNATION: *Acteon Wetherellii* [Wetherilli] Isaac Lea. Miocene of New Jersey.



The name *Acteocina* was used by Gray in 1847 as a possible subgenus of *Acteon*. He gave no description but selected as his type "*Acteon Wetherellii* Lea," which is not an *Acteon* but a member of the group more commonly known under Adams' name *Tornatina*.

Shell small, cylindrical or fusiform, thin, inflated. Protoconch papillate and heterostrophous, coiled at right angles to the axis of the conch. Spire evolute. Sutures channeled. Sculpture absent or feeble. Aperture narrow, in many species sublinear. Outer lip simple. Columella reinforced, monoplicate.

Most of the Recent species of *Acteocina* are denizens of the warmer waters ranging in depth from the littoral zone to more than 200 fathoms.

*Acteocina melinoides* Gardner, n. sp.

(Plate 27, figures 21, 23)

Shell small even for the group, moderately stout, subcylindrical. Protoconch minute, paucispiral, capping the spire at a right angle to the axis of the conch. Whorls of conch between 2 and  $2\frac{1}{4}$ , the exposed portion of the spire very narrow. Body and closing whorl of spire obtusely shouldered, the sides subparallel. Sutures channeled. Outer surface smooth, probably polished when fresh, even the incremental sculpture exceedingly faint. Aperture narrow, expanding anteriorly with the constriction of the body. Outer lip vertical. Characters of inner lip obscured by the matrix which fills the mouth. Pillar margin thickened. Anterior extremity of shell subtruncate.

DIMENSIONS OF HOLOTYPE: Height, 3.6 millimeters; diameter, 1.8 millimeters. Paratype: Height, 3.3 millimeters; diameter, 1.7 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497434. Paratype: U. S. Nat. Mus. 497433.

TYPE LOCALITY: Holotype, U.S.G.S. sta. 13513 (M-11). Paratype: U.S.G.S. sta. 13504 (M-8). Jackson formation.

There is nothing very close to this small form among the described species. The genus is extremely rare in the Eocene, and *A. melinoides* stands apart from the few known forms because of its low spire and squat, cylindrical outline. *Tornatina angelinae* Van Winkle, 1919, described from the Jackson of Angelina County, Texas, is stouter, and the type is said to measure 23.0 millimeters in height by 13.0 millimeters in diameter.

DISTRIBUTION: Jackson formation: lower or middle Jackson, U.S.G.S. sta. 13504 (M-8); U.S.G.S. sta. 13503 (N-8); upper Jackson, U.S.G.S. sta. 13513 (M-11).

Genus *Volvulella* Bullen-Newton

1891. *Volvulella* BULLEN-NEWTON, Systematic list British Oligocene and Eocene Mollusca, p. 268.  
*Volvula* ARTHUR ADAMS, in SOWERBY, Thesaurus conchyliorum, pt. 11, p. 558, 1850.  
 Not *Volvula* GISTL, 1848; Diptera.

TYPE, BY SUBSEQUENT DESIGNATION (Bucquoy, Dautzenberg, and Dollfus, Mollusques marins du Roussillon, vol. 1, p. 533, 1886): *Bulla* (*Volvula*) *rostrata* A. Adams. Recent off Australia.

"Shell subcylindrical, beaked at both ends; spire concealed; aperture narrow; inner lip with a single obsolete fold."—A. Adams, 1850.

The genus is unusually well characterized among the tectibranchs by the rostrate or spinose posterior extremity.

*Volvulella* has been recognized in most of the large Tertiary faunas, both American and European. Between 25 and 50 Recent species have been described from various parts of the globe, most of them, however, from the warm temperate and tropical waters at depths not greater than 100 fathoms.

*Volvulella garzai* Gardner, n. sp.

(Plate 27, figure 24)

Shell small even for the group, minutely lenticular, subacutely tapering both apically and anteriorly. Apical spine possibly developed but lost or worn down by erosion. Aperture sublinear through most of its extent, expanding slightly with the constriction at the base of the body. Outer lip arcuate, roughly parallel to the curvature of the body. Matrix largely concealing the characters of the anterior half of the aperture. Pillar margin reinforced. Aperture anteriorly produced and narrowly rounded at its extremity.



DIMENSIONS OF HOLOTYPE: Height, 2.8 millimeters; diameter, 1.2 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497435.

TYPE LOCALITY: U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7° 15' E. of Ciudad Camargo, Tamaulipas, Mexico. Jackson formation.

*Volvulella garzai* may well be in the line of descent from *V. conradiana* Gabb, a more slender species, more acutely tapering posteriorly. Gabb's species was described either from Wheelock or from Caldwell County, Texas. It is reported from the lower Claiborne of both localities. *Volvulella volutata* (Meyer and Aldrich) (Plate 27, figures 28, 29), with the same general distribution, is larger and less slender, and the apical portion of the shell is more conical than in either *V. garzai* or *V. conradiana*. *V. garzai* is known only from the Jackson of the Camargo area.

DISTRIBUTION: Jackson formation: lower or middle Jackson, U.S.G.S. sta. 13504 (M-8); U.S.G.S. sta. 13503 (N-8).

#### Family ATYIDAE

##### Genus *Atys* Montfort

1810. *Atys* MONTFORT, Conchyliologie systématique, vol. 2, p. 343.

TYPE, BY ORIGINAL DESIGNATION: *Atys cymbulus* Montfort = *Bulla naucum* Linnaeus. Recent in the Indo-Pacific.

Shell very thin, inflated, often globose, ovate or cylindrical in outline. Spire involute, occulted. External surface spirally sulcate, as a rule, toward the extremities; free from sculpture medially. Aperture arcuate, more produced than the body both anteriorly and posteriorly, sharply constricted behind the vertex and in the true *Atys* twisted or plicate on its inner margin; outer lip thin, sharp, expanded, patulous anteriorly. Inner lip short, usually obliquely plicate or truncate. Umbilicus in the typical forms narrowly perforate.

##### Subgenus *Aliculastrum* Pilsbry

1896. *Aliculastrum* PILSBRY, Manual of Conchology, ser. 1, vol. 16, p. 237.

1831. *Alicula* EHRENBERG, Symbolae physicae, seu icones et descriptiones, vol. 4, p. 41 of Moll. Not *Alicula* EICHWALD, 1830, Naturhistorische Skizze von Lithauen, Volhynien und Podolien in geognostisch-mineralogischen, botanischen und zoologischen Hinsicht entworfen, p. 214.

1928. *Aliculastrum* Pilsbry. WOODRING, Carnegie Inst. Washington, Pub. 385, p. 127.

TYPE BY MONOTYPY: *Bulla cylindrica* Helbling. Recent in the Indo-Pacific.

*Aliculastrum* is separated from the typical *Atys* by the less inflated, more cylindrical outline and the obscure or obsolete plication of the columella. It shares with *Atys*, however, the characteristic twist of the lip behind the vertex.

##### *Atys?* (*Aliculastrum?*) sp.

(Plate 27, figure 22)

A small species, characterized by a short inflated body, involute spire, imperforate apex, and outer lip produced posteriorly and patulous anteriorly, is recorded by a mold from beds of Jackson age near Camargo, Tamaulipas.

Similar forms from higher beds have been called *Atys* (*Aliculastrum*), but the Indo-Pacific types of that genus and subgenus are eight or ten times as great as the western Tertiary species which have been referred to them.

The height of the figured specimen, U. S. Nat. Mus. 497439, is 3.2 millimeters; the diameter, 1.8 millimeters. It was collected from the lower or middle part of the Jackson formation, at U.S.G.S. sta. 13504 (M-8), 15.9 kilometers S. 7° 30' E. of Ciudad Camargo, Tamaulipas.

#### Family SCAPHANDRIDAE

##### Genus *Lithophysema* Stewart

1927. *Lithophysema* STEWART, Acad. Nat. Sci. Philadelphia, Proc., vol. 78, p. 438.

TYPE, BY MONOTYPY: *Haminea grandis* Aldrich. Jackson of Louisiana.

"*Haminea* *grandis* Aldrich from the Eocene of Louisiana has been called a *Scaphander* (Dall, Wagner Free Inst. Sci. Trans., vol. 3, pt. 1, p. 17, pl. 10, fig. 9, 1890) but it has a perforated apex and



straighter columella. It much resembles the living *Abderospira cranchii* (Fleming) but because of its giant size—some individuals were more than 120 mm. long—and absence of punctate sculpture, it is considered a distinct genus and here named *Lithophysema*." Stewart, 1926.

The group is restricted in its known distribution both in time and place. Only two species have been recognized—the genotype, *Lithophysema grande* (the generic name is neuter), recovered from both the Jackson of the western Gulf and the Ocala limestone of Florida, and *L. stewarti* Gardner, from the upper Jackson of northeastern Mexico.

*Lithophysema stewarti* Gardner, n. sp.

(Plate 12, figures 1, 4)

Shell very large for the group, bulliform. Apex narrowly perforate. Outer apertural margin produced backward then turning sharply and roughly paralleling the body whorl as far as its basal constriction. Inner apertural margin inversely sigmoidal. Aperture very narrow posteriorly, the outer lip nearly vertical, expanding anteriorly with the constriction of the body and produced beyond the base of the body for about one third the total height of the shell. Entire outer surface sculptured with narrow straight-sided spiral grooves separated by flat interspaces about double the width of the grooves.

DIMENSIONS OF HOLOTYPE: Height, 78 millimeters; diameter, 50 millimeters.

HOLOTYPE: U. S. Nat. Mus. 494948.

TYPE LOCALITY: U.S.G.S. sta. 13527 (M-11). In Arroyo San Antonio, 1676 meters west-southwest of Rancho Llanitos, Zacate, Nuevo León. Upper part of Jackson formation according to the field evidence.

The eastern and the western Gulf species are very close, but the eastern Gulf form, the genotype *Lithophysema grande* (Aldrich), shows a wider aperture, more produced posterior to the body whorl. The holotype of *L. stewarti* seems a little less globose, but this may be due to imperfect preservation.

The species is named in honor of the author of the genus, Ralph Stewart.

Genus *Cylichna* Lovén

1846. *Cylichna* LOVÉN, Index molluscorum Litora Scandinaviae occidentalia habitantium, p. 10; Öfversigt Kongl. vetensk. Akad. Förh., Arg. 3, no. 5, p. 142.  
Not *Cylichnus* BURMEISTER, 1844, Handbuch der Entomologie, Band 4 (1), p. 171.  
1891. *Bulinella* BULLEN-NEWTON, Systematic list of the Edwards collection of British Oligocene and Eocene Mollusca, p. 265 (part).

TYPE, BY SUBSEQUENT DESIGNATION (Herrmannsen, Indicis generum malacozoorum, Primordia vol. 2, Supplementa et corrigenda, p. 42, 1852): *Bulla cylindracea* Pennant. Recent off the west coast of Europe. Reported from the European Pliocene and Pleistocene.

Shell small, subcylindrical. Spire involute. Apex sunken and, in the young at least, perforate. Posterior extremity planed in *Cylichna* s.s. External surface smooth except for faint spiral striae, least feeble anteriorly. Aperture narrow, dilated in front. Outer lip thin, sharp, following the curvature of the body through more than half its extent. Pillar reinforced, twisted slightly. Umbilicus closed in *Cylichna* s.s.

*Cylichna* has been reported from strata as old as the Triassic. Between 75 and 100 Recent species have been described, ranging in latitude from the Arctic seas to the Tropics and in depth from less than 25 fathoms to almost 2000 fathoms.

Bullen-Newton wished to discard *Cylichna* because of the priority of *Cylichnus*, a genus of the Coleoptera, but such a procedure is not within the law.

Subgenus *Acrotrema* Cossmann

1889. *Acrotrema* COSSMANN, Soc. Royale Malacolog. Belgique Annales, vol. 24, p. 317.  
1895. *Acrotrema* COSSMANN, Essais paléoconchologie comp., vol. 1, p. 95.

TYPE, BY ORIGINAL DESIGNATION: *Bulla cylindroides* Deshayes. Mid-Eocene (Calcaire Grossier) of the Paris Basin.

*Acrotrema* was described as a section of *Cylichna*; a perforate apex, an occulted spire, and a cylindrical or conical outline are among the characteristic features. In 1895, Cossmann referred his new section to the synonymy of *Cylichnina*. It is here revived to include a number of species both from



the mid-Eocene of the Paris Basin and of the Gulf not satisfactorily covered by either *Cylichna* or *Cylichnina*. The group typified by *Bulla cylindroides* Deshayes recalls *Cylichna* in form and dimensions, but the posterior extremity of *Cylichna* is truncated and planed, while that of *Acrotrema* exhibits an *Atys*-like backward projection of the outer lip. *Cylichnina* is smaller and stouter, and the backward buckling of the labrum is much less marked. The pillar wash in *Acrotrema* is not fused with the base of the body wall, as it is in *Cylichna*, but is merely reverted, leaving at least a suggestion of an umbilical chink. In *Cylichnina*, there is a similar chink, but there is also a twist to the pillar not shown in *Acrotrema*. In all three of these groups, the sculpture is absent or restricted to microscopically fine striae, least faint toward the anterior extremity.

The differences separating *Acrotrema* from *Cylichna* seem less critical than those which divide *Acrotrema* and *Cylichnina*, but the classification of the opisthobranchs, which is based primarily on the soft parts, cannot be made with assurance from the shells alone. *Acrotrema*, as it is understood in this report, includes a group of species distributed rather widely but not abundantly in the Eocene of the Paris Basin and the Gulf Province. Possibly *Cylichna*, which occupies a somewhat analogous position in the Miocene faunas, may be in the line of descent.

*Cylichna (Acrotrema) kellogii* (Gabb)

(Plate 27, figure 27)

1860. *Bulla Kellogii* GABB, Acad. Nat. Sci. Philadelphia, Jour., ser. 2, vol. 4, p. 386, pl. 67, fig. 50.  
 1865. *Cylichna kellogii* Gabb. CONRAD, Am. Jour. Conchology, vol. 1, p. 35.  
 1931. *Cylichna kellogii* Gabb. RENICK AND STENZEL, Univ. Texas Bull. 3101, pp. 100, 106.  
 1937. *Cylichnina kellogii* (Gabb). PALMER, Bull. Am. Paleontology, vol. 7, no. 32, p. 481, pl. 75, figs. 13, 21; pl. 90, fig. 11.

"Subcylindrical; spire hidden; mouth linear, outer lip straight; umbilicus rudimentary, surface smooth.

"*Dimensions*.—Length .14 in., width .07 in.

"Rare, but I have seen it both from Wheelock and Caldwell Co." Gabb, 1860.

*Cylichna (Acrotrema) kellogii* (Gabb) is probably the most widely distributed opisthobranch in the western Gulf region. Specimens 7 and 8 millimeters high are not at all uncommon in the lower Claiborne of Texas, and a few individuals reach a full centimeter. The shell is rolled smoothly back from the deep and moderately wide apical perforation, and the buckling at the outer lip is narrow but produced for an appreciable distance behind the apex. Faint wavy striae encircle the anterior third of the shell and are developed fortuitously at the posterior collar. The anterior portion of the aperture expands slightly with the constriction of the body. The outer lip is somewhat patulous, and the callus along the pillar is reverted, almost closing the umbilicus. The anterior extremity is obtusely truncate.

DIMENSIONS OF FIGURED SPECIMEN (U. S. Nat. Mus. 497436): Height, 4.5 millimeters; diameter, 1.7 millimeters.

LOCALITY: U.S.G.S. sta. 13861 (H-4), middle part of the Laredo formation.

A number of indeterminate opisthobranchs in the Laredo of Mexico may be referable to *C. kellogii*, but the species is neither so common nor so widely distributed as it is in Texas.

*Cylichna (Acrotrema) sp. cf. C. (A.) kellogii* (Gabb)

(Plate 27, figure 30)

A closely allied form, more narrowly perforate posteriorly and possibly more slender relatively, is not uncommon at U.S.G.S. sta. 13643 (M-25).

The figured specimen (U. S. Nat. Mus. 497437) is 5.5 millimeters high and 2.1 millimeters in diameter. The horizon is in the middle part of the Laredo formation.

*Cylichna (Acrotrema) agatha* Gardner, n. sp.

(Plate 27, figures 32, 33)

Shell large for the group and heavy. Outline moderately slender, subcylindrical. Outer lip rolled backward from the narrowly perforate apex, produced beyond the body, curved parallel to the body in its medial portion along the horizontal axis. Wavy striae girding the anterior portion and the



posterior extremity around the apical opening. Aperture sublinear medially, expanding slightly posteriorly with the constriction of the body and to a greater degree anteriorly. Parietal wash thin, fused with the heavier wash which almost closes the umbilicus. Aperture slightly patulous and broadly rounded at its anterior extremity.

DIMENSIONS OF HOLOTYPE: Height, 12.6 millimeters; diameter, 5.2 millimeters.

HOLOTYPE: U. S. Nat. Mus. 497438.

TYPE LOCALITY: U.S.G.S. sta. 13569 (H-12), General Bravo, Carlos Cantú, Nuevo León. Middle part of the Laredo formation.

*Cylichna agatha* is larger, less slender, and more narrowly perforate than *C. kellogii* (Gabb). In absolute dimensions, it closely approaches *C. galba* (Conrad), but the apical perforation of the later species is wider, and there is an insinuation of the outer lip similar to though less pronounced than that of *Atys*.

*Cylichna (Acrotrema) sp. cf. C. (A.) jacksonensis* Meyer

(Plate 27, figure 31)

*Cylichna jacksonensis* Meyer (Geol. Survey Alabama, Bull. 1, p. 77, pl. 2, fig. 25, 1886) was described as follows:

"Length two and a half times the breadth; umbilicate at the top and with an umbilicate fissure at the columella; the faint impressed, revolving lines are more distinct near the base and the top.

"Locality.—Jackson, Miss."

The species from the upper part of the Jackson formation in Nuevo León is a little larger than the figured type and the topotypes in our collections. The apical perforation is wider, and the insinuation of the outer lip directly behind the apex seems less marked in the Mexican species. The character of the exceedingly faint sculpture is similar in the two forms.

The figured specimen (U. S. Nat. Mus. 497448 from U.S.G.S. sta. 13513, M-11), has been slightly warped so that it appears stouter than it really was. It is 8.5 millimeters high and 4.5 millimeters in diameter.

Genus *Cylichnella* Gabb

1873. *Cylichnella* GABB, Acad. Nat. Sci. Philadelphia, Proc. for 1872, p. 273.

TYPE, BY MONOTYPY: *Bulla bidentata* d'Orbigny. Recent in the West Indies.

Shell very small, subcylindrical, short, smooth as a rule except for faint anterior spirals; spire involute, the apex slightly depressed. Aperture narrow, patulous anteriorly and widening with the constriction of the body; the outer lip paralleling the body posteriorly, vertical medially, produced beyond the body in front. Parietal wall thinly washed with callus. Columella biplicate, the anterior fold marginal, the posterior continuous with the posterior edge of the umbilical callus.

*Cylichnella* has been recorded from the Eocene of the Loire valley. The Recent species are apparently restricted in their distribution to the east coast of North America from Maine southward.

*Cylichnella* sp.

A single individual (U. S. Nat. Mus. 495185) was recovered from the lower part of the Midway formation at U.S.G.S. sta. 13473(B-6), 5.5 kilometers south-southeast of Agualeguas, Nuevo León. The specimen measures 3.3 millimeters in height and 1.8 millimeters in diameter and is preserved as a highly crystallized shell. No characters are retained by which it can be separated from the usually later Tertiary and Recent *Cylichnella*. It is a very stout little form with a relatively wide aperture and an outer lip which is produced slightly beyond the body whorl posteriorly and forms the outer margin of the distinctly patulous aperture. The inner lip is reverted and much thickened in the umbilical area, and the posterior margin of the callus is continuous with the posterior fold on the columella. No sculpture has been observed.

This is perhaps the first record of the genus at so low a horizon.

Genus *Cylichnina* Monterosato

1884. *Cylichnina* MONTEROSATO, Nomenclatura generica e specifica di alcune conchiglie mediterranee, Palermo, p. 143.



TYPE, BY SUBSEQUENT DESIGNATION (Bucquoy, Dautzenberg and Dollfus, *Les mollusques marins du Roussillon*, vol. 1, p. 524, 1886): *Bulla umbilicata* Montagu. Recent on the European shores from the Shetland Islands to the Mediterranean Sea.

Shell small, involute, subcylindrical, the body whorl of the adult more or less conoidal, as a rule, tapering posteriorly. External surface smooth or axially striated, more rarely spirally lineated. Aperture longer than the body, more or less produced behind and patulous anteriorly. Columella nonplicate. Apex perforate. Umbilicus imperforate.

*Cylichnina* sp.

Small forms certainly referable to *Cylichnina*, but not specifically determinable, occur in the lower part of the Indio formation at U.S.G.S. sta. 13669 (E-12), north of La Laja, Nuevo León.

Order PTEROPODA

Suborder THECOSOMATA

Family CAVOLINIDAE

Genus *Tibiella* Meyer

1884. *Tibiella* MEYER, Acad. Nat. Sci. Philadelphia, Proc. for 1884, p. 110.

1934. *Tibiella* Meyer. COLLINS, Johns Hopkins Univ., Studies in Geology, no. 11, p. 226.

TYPE, BY MONOTYPY: *Tibiella marshi* Meyer. Claiborne group, Claiborne, Alabama.

The description of the genus and of the genotype are given as one:

"Shell thin, tubular. The closed end little convex. The lower part, about one third of the whole length, of a circular section, then by tapering a little forming a kind of a neck, above which the shell is of a rounded trigonal section. Aperture dilated.

"Length,  $3\frac{1}{2}$  mm.

"*Locality*.—Eocene sand from Claiborne, Ala.

"*Remarks*.—If the figured specimen is adult, in the young ones the apex may be perhaps acute and afterwards partitioned off, as in the genus *Triptera* Quoy et Gaimard (*Cuviera* Rang).

"This genus is allied to *Tibiella*, and the latter is perhaps a subgenus of the former." Meyer, 1884.

Lee Collins, who monographed the American Tertiary pteropods, did not have sufficient additional material to be sure of the degree of the relationship to *Cuvierina* Boas, 1886.

*Tibiella?* sp. ind.

A closed tube 2.3 millimeters long and a little more than .5 millimeter wide in the middle part of the Indio formation at U.S.G.S. sta. 13675 (E-9) is probably referable to *Tibiella*. The tube is more nearly uniform in diameter than either *T. marshi* Meyer or *T. texana* Collins. The posterior extremity is apparently sealed, and the anterior is constricted slightly behind the terminal collar.

Subclass PULMONATA

Superfamily BULIMULACEA

Family UROCOPTIDAE

Genus *Holospira* Martens

*Holospira eva* Gardner, n. sp.

(Plate 10, figure 21)

Shell moderately large for the group, cylindrical. More than 10 whorls in the holotype, the first 2 included in the small, low, blunt protoconch. Earlier whorls of conch narrow, increasing in diameter relatively fast and with regularity so that the earlier half of the conch resembles in outline a small, slender beehive; no increase in the diameter of the whorls on the medial or anterior portions, and a slight decrease in diameter at the body. A slight increase in the height of the whorls anteriorly, and the body drawn out a little and smoothly rounded at the base. Sutures distinct, impressed but not



interrupting the regularity of the cylindrical profile. Surface roughened by strongly retractive growth ridges, in alignment at the sutures and each series performing about half a revolution. Aperture a little higher than it is wide. Outer lip possibly broken slightly at the margin. Peristome continuous, flaring a little, adnate to the body wall along the posterior fourth, transgressing a little on the final whorl of the spire. Umbilical pit small, not very deep.

**DIMENSIONS OF HOLOTYPE:** Height, 17.5 millimeters; diameter, 6.4 millimeters.

**HOLOTYPE:** U. S. Nat. Mus. 497095.

**TYPE LOCALITY:** U.S.G.S. sta. 13583, 9 kilometers due south of Mendez, Tamaulipas. Upper part of Oligocene series.

A second species of *Holospira* of middle Oligocene age may be represented in the smaller, relatively stouter forms abundant at U.S.G.S. sta. 13539 (N-17). One individual from Rancho Miralejas has retained the laminar varical ring surrounding the aperture.

The genus is well represented in Mexico, but nothing close specifically to the Oligocene form has been found. Most of the Recent species are relatively higher, with more numerous whorls and distinct apertural characters. The West Indian group, *Urocoptis* (*Urocoptis*), includes only decollate forms. The species discussed and figured under *Pupa Leidyi* Meek? by White (U. S. Geol. Survey, Bull. 34, p. 27, pl. 5, figs. 8-10, 1886) from the Puerco of New Mexico has a more rounded aperture but from the illustration seems surprisingly similar in general characters. Associated with the "Pupa" are helicoids resembling the Mexican Oligocene helicoids and those living in Mexico today. There is no obvious reason why the assemblage of land shells should present a more modern appearance than the marine fauna from the same area, but it does.

**DISTRIBUTION:** Oligocene series. Lower marine Oligocene sandstone: ?U.S.G.S. sta. 13509 (M-11); ?U.S.G.S. sta. 13510 (M-11); upper Oligocene limestone: U.S.G.S. sta. 13583 (P-27).

#### Superfamily HELICACEA

##### "*Helix*" sp.

(Plate 18, figures 1-3)

Shell of moderate dimensions for the group, depressed, subdiscoidal, commonly warped, the whorls slightly exceeding 4 in number. Periphery acute in the young and adolescent forms, rounded in the adults. Base rounding obliquely into the subacute peripheral keel. Fragments of a moderately heavy shell adherent in some individuals. Growth lines retractive. Sutures deeply impressed. Characters of aperture lost. Outer lip probably thin, following the outline of the body. Umbilicus probably open, broadly and deeply funicular.

**DIMENSIONS OF FIGURED SPECIMEN:** Height, 23.5 millimeters; diameter, 42 millimeters.

**FIGURED SPECIMEN:** U. S. Nat. Mus. 497132.

**LOCALITY OF FIGURED SPECIMEN:** U.S.G.S. sta. 13517 (N-15). Base of upper Middle Oligocene sandstone.

If the margin of the outer lip was originally thickened, no trace of such a varix nor of any oral armature remains. The species is almost certainly referable to the Helicacea and probably to the subfamily Epiphragmophorinae. It has much in common with *Lysinoe* H. and A. Adams, 1855, a group widely distributed in Mexico today, but none of the observed species of *Lysinoe* are so angulated at the periphery, and in none of them is the umbilical funnel so wide nor the umbilical keel so pronounced.

The species is abundant at a few localities near the base of the upper Middle Oligocene. At U.S.G.S. sta. 14023 (N-13) and U.S.G.S. sta. 13517 (N-15), the matrix is a hard conglomeratic ashy and locally siliceous sandstone. At U.S.G.S. sta. 14023, the species is associated with *Hemisinus*, *Erodona*, and *Ampullina* in great numbers and a few scattered truly marine forms. At U.S.G.S. sta. 13517, no associated fauna is recorded.

Other large shells, possibly helicoids, possibly naticoids, occur in the lower marine Oligocene sandstone at U.S.G.S. sta. 13510 (M-11). They may represent the same species as the helicoids occurring in the higher Oligocene, but the periphery seems much more rounded. Other forms suggesting naticoids in the full, rounded periphery occur in the lower Oligocene sandstone at U.S.G.S. sta. 13521 (M-10).



## Class CEPHALOPODA

## Order NAUTILOIDEA

## Family CLYDONAUTILIDAE

Genus *Hercoglossa* Conrad

1866. *Hercoglossa* CONRAD, Am. Jour. Conchology, vol. 2, p. 101.  
 1883. *Enclimatoceras* HYATT, Boston Soc. Nat. Hist., Proc., vol. 22, p. 270. Holotype: *Nautilus ulrichi* (White).  
 1933. *Hercoglossa* MILLER AND THOMPSON, Jour. Paleont., vol. 7, p. 313.  
 1933. *Cimomia* MILLER AND THOMPSON, Jour. Paleont., vol. 7, p. 305, (in part).  
 Not *Cimomia* Conrad, T. A., Am. Jour. Conchology, vol. 2, p. 102, 1866.

TYPE, BY SUBSEQUENT DESIGNATION (Hyatt, Boston Soc. Nat. Hist., Proc., vol. 22, p. 270, 1883): *Nautilus orbiculatus* Tuomey. Midway of Alabama.

*Hercoglossa* sp. cf. *H. vauhani* Gardner

(Plate 5, figure 5)

1923. *Enclimatoceras vauhani* GARDNER, U. S. Geol. Survey Prof. Paper 131-D, p. 115, pl. 33, figs. 1-3.  
 1933. *Hercoglossa vauhani* Gardner. PLUMMER, Univ. Texas. Bull. 3232, p. 817, fig. 53.  
 1933. *Cimomia vauhani* (Gardner). MILLER AND THOMPSON, Jour. Paleont., vol. 7, no. 3, p. 307.  
 1935. *Hercoglossa vauhani* GARDNER, Univ. Texas Bull. 3301, pp. 322-323, pl. 27, pl. 28, figs. 1, 2.  
 (Not 1933 as on title page.)

Shell large, rather compressed toward the apex, more broadly rounded ventrally toward the aperture, obliquely flattened laterally. Whorls numerous, increasing but slowly in latitude. Altitude of the earlier whorls a little more than three times their average width from suture to suture; of the later whorls a little less. Final whorl of a half-grown specimen rudely reniform, somewhat auriculate laterally, concave, the diameter of the whorl approximately double the altitude. Umbilici rather strongly depressed, their peripheries obscurely carinate. Ventral saddle broad and nearly horizontal. Lateral lobes broad and shallow. Lateral saddles relatively narrow and moderately deep. Siphuncle dorsal, migrating slowly toward the center with increasing age. Surface not known.

DIMENSIONS: Holotype: Maximum diameter of shell, 168 millimeters, diameter of shell at right angles to maximum diameter, 140 millimeters; thickness, 100 millimeters. Adolescent paratype: Maximum diameter of shell, 93 millimeters; diameter of shell at right angles to maximum diameter, 64 millimeters; maximum thickness, 73 millimeters. A larger but imperfect individual attains a maximum diameter of 220 millimeters.

TYPE LOCALITY: U.S.G.S. sta. 3178, three fourths mile northwest of Myrick's (Evans's) apiary, Frio River, Uvalde County, Texas.

This is one of a large group of species of world-wide distribution in the late Cretaceous and early Eocene.

A fragment from U. S. Nat. Mus. 494962 from the lower part of the Midway formation at U.S.G.S. sta. 13459 (B-6), 5.5 kilometers south-southeast of Agualeguas, retains no characters by which it can be separated from *Hercoglossa vauhani*.

Genus *Aturia* Bronn

The nautiloids from northeastern Mexico referable to the genus *Aturia* Bronn, 1838, were submitted to A. K. Miller of the University of Iowa and are covered by the report of Miller and Furnish (Jour. Paleont., vol. 12, no. 2, pp. 149-155, pl. 25, figures 1-7, 2 text figures, 1938). The genus was recognized in the Mount Selman formation at U.S.G.S. sta. 13262 (F-11), Nuevo León; the Jackson formation of Nuevo León and Tamaulipas; and the lower marine Oligocene sandstone of Nuevo León. In 2 localities only was specifically determinable material found. *Aturia alabamensis* (Morton) reported from the Castle Hayne marl of North Carolina, the Ocala limestone of eastern Alabama and Florida, and the Jackson of western Alabama and Mississippi was recognized in the lower or middle Jackson at U.S.G.S. sta. 13507 (M-7) in the Camargo district, Tamaulipas and at U.S.G. S. sta. 13510 from the lower marine sandstone now referred to the lower Oligocene.



## Phylum ARTHROPODA

## Subphylum INSECTA

## Order HYMENOPTERA

Genus *Celliforma* Brown

1934. *Celliforma* BROWN, Washington Acad. Sci., Jour., vol. 24, p. 532.

1935. *Celliforma* BROWN, Washington Acad. Sci., Jour., vol. 25, p. 526.

TYPE, BY SUBSEQUENT DESIGNATION (Brown, 1935): *Celliforma spirifer* Brown. Bridger formation (lower Eocene) of Wyoming.

Tubes of an unknown origin have been appearing from time to time in the collections made in the Tertiary deposits both of the Western Interior and of the Gulf region. They were shifted about through the animal and vegetable kingdoms but were most commonly considered as *Lithophaga* burrows. No satisfactory exposition of their true nature was advanced until Roland Brown, paleobotanist on the U. S. Geological Survey, correlated some scattered records and observations and interpreted them as the fossil larval chambers of mining bees. The characteristic feature of the bee chambers is the low dextrally spiral apex of 4 or 5 volutions. Not all the tubes in our collections retain the apex. Many of them probably never possessed it, and these may be molds of *Lithophaga*s. The base of a tube either of molluscan or of insect origin is like that of a test tube. The apex of *Celliforma* suggests in form and outline that of many of the low-spined cones or of some of the opisthobranchs. The tubes may be regular or slightly warped. They vary in relative dimensions, the diameter averaging from a third to half the height. A comparison with the larval chambers of living mining bees reveals a striking similarity between the fossils and the Recent forms. Not only are they similar in outline and dimensions but also in the polished inner surface and the details of the apical sculpture. Similar chambers in which they may accomplish their metamorphoses are prepared by the living Hymenoptera.

"If the identification of these fossils as stated here is correct, the unbroken specimens with seal intact suggest, in effect, tragic incidents of the insect world of 30 million years ago. Then, as now, on account of parasitism and other causes, many bee larvae never matured to break the seals of their earthen chambers and to emerge as adults. The fossil molds are the only records of their frustrated lives." (Brown, 1934.)

In 1935, Brown assembled some further observations and defined his genus more exactly. "I therefore propose that the term *Celliforma* be the generic name to include all fossil fillings of chambers purporting to have been made originally by unknown mining Hymenoptera, and I designate *Celliforma spirifer* Brown, from the Bridger formation of Wyoming as the genotype. The specimens from the 'silex beds' of the Tampa limestone of Florida may be known as *Celliforma nuda* (Dall) Brown, new combination, and Schutze's specimens, from the Oligocene of Weilheim, Germany, as *Celliforma germanica* Brown, new name."

*Celliforma?* sp.

(Plate 10, figures 5, 6)

The blunt and evenly rounded end of structureless tubes, U. S. Nat. Mus. 495924, from the lower Oligocene sandstone at U.S.G.S. sta. 13537 (M-14) cannot be separated from the molds of the larval chambers in the Museum collections from the lower Miocene of Florida. Only the basal fraction, possibly about half the original tube, remains. In the specimens from the Mexican collections, the diagnostic upper portion bearing the spiral seal has been broken away and with it the feature which definitely separates the molds of the larval chambers from the burrows of *Lithophaga* or some other mollusk of similar habits. Other examples were collected from a possibly synchronous horizon at U.S.G.S. sta. 13509 (M-11).

If *Celliforma* is represented in these fragments, a new horizon for the occurrence of the genus is here recorded.



## BIBLIOGRAPHY

- Aguilera, José G.** (1897) *Bosquejo geológico de México: Itinerarios geológicos: San Luis, Nuevo León y Tamaulipas*, Instituto geológico de México, Bull., nos. 4, 5, 6, pp. 122-132.
- Belt, Ben C.** (1925) *Chapeño salt dome, Tamaulipas, Mexico*, Am. Assoc. Petrol. Geol., Bull., vol. 9, no. 1, pp. 134-135.
- Böse, Emil** (1923) *Vestiges of an ancient continent in northeast Mexico*, Am. Jour. Sci., 5th ser., vol. 6, pp. 127-136, fig. 1; Part 2, pp. 196-214, 2 tables, fig. 2; Part 3, pp. 310-337, figs. 3A, 3B, 4.
- , and **Cavins, O. A.** (1927) *The Cretaceous and Tertiary of southern Texas and northern Mexico*, Univ. Texas Bull. 2748, pp. 1-142.
- Bowles, Edgar** (1939) *Eocene and Paleocene Turritellidae of the Atlantic and Gulf Coastal Plain of North America*, Jour. Paleont., vol. 13, no. 3, pp. 267-336, pls. 31-34.
- Brantley, J. E.** (1924) *Résumé of the geology of the Gulf Coastal Plain*, Am. Assoc. Petrol. Geol., Bull., vol. 8, pp. 21-28.
- Conrad, T. A.** (1857) *Descriptions of Cretaceous and Tertiary fossils: In Emory, William H., Report on the United States and Mexican Boundary Survey*, U. S., 34th Cong., 1st sess., Senate Ex. Doc. 108 and House Ex. Doc. 135, vol. 1, pt. 2, pp. 141-174, pls. 1-21.
- Cooke, C. Wythe, Gardner, Julia, and Woodring, Wendell P.** (1943) *Correlation of the Cenozoic formations of the Atlantic and Gulf Coastal Plain and the Caribbean Region*, Geol. Soc. Am., Bull., vol. 54, pp. 1713-1723, 1 pl.
- Dickerson, Roy E.** (1917) *Ancient Panama canals*, Calif. Acad. Sci., Pr., 4th ser., vol. 7, pp. 197-205.
- , and **Kew, W. S. W.** (1917) *The fauna of a medial Tertiary formation and the associated horizons of northeastern Mexico*, Calif. Acad. Sci., Pr., 4th ser., vol. 7, pp. 125-156, pls. 17-26a.
- Dumble, E. T.** (1908) *Tertiary deposits of northeastern Mexico*, Science, n. ser., vol. 27, p. 273.
- (1911) *Tertiary deposits of northeastern Mexico*, Science, n. ser., vol. 33, p. 232-234.
- (1912) *Tertiary deposits of eastern Mexico*, Science, n. ser., vol. 35, pp. 906-908.
- (Sept.-Oct., 1915) *Some events in the Eocene history of the present coastal area of the Gulf of Mexico in Texas and Mexico*, Jour. Geol., vol. 23, pp. 481-498, fig. 1 (map).
- (Dec. 31, 1915) *Tertiary deposits of northeastern Mexico*, Calif. Acad. Sci., Pr., 4th ser., vol. 5, 163-193, pls. 16-19.
- (1916) *The occurrences of petroleum in eastern Mexico as contrasted with those in Texas and Louisiana*, Am. Inst. Min. Metall. Eng., Tr., vol. 52, pp. 250-267.
- (1918) *Geology of the northern end of the Tampico Embayment area*, Calif. Acad. Sci., Pr., 4th ser., vol. 8, pp. 113-156, pls. 3-6.
- (1920) *Geology of East Texas*, Univ. Texas Bull. 1869, pp. i-vii; 1-388, pls. 1-12.
- Emory, W. H.** (1857) *Report on the United States and Mexican Boundary Survey*, U. S., 34th Cong., 1st sess., Senate Ex. Doc. 108 and House Ex. Doc. 135, vol. 1, pt. 1, pp. 1-258; 64 steel engravings; 1 geologic section; 1 meteorological diagram; 1 map showing magnetic lines; 12 stone engravings; 20 wood cuts.
- Gardner, Julia** (June, 1935) *The Midway group of Texas*, Univ. Texas Bull. 3301, pp. 1-403, 4 text figs., 28 pls.
- (July, 1938) *Laredo, a new name for a unit of Cook Mountain age in the Rio Grande region*, Washington Acad. Sci., Jour., vol. 28, no. 7, pp. 297, 298.
- , and **Bowles, Edgar** (1939) *The Venericardia planicosta group in the Gulf Province*, U. S. Geol. Survey, Prof. Paper 189-F, pp. 143-215, pls. 29-46; fig. 27; charts 1-3.
- Garfias, V. R.** (1915) *The oil region of northeastern Mexico*, Econ. Geol., vol. 10, pp. 195-224.
- Getzendaner, F. M.** (1930) *Geologic section of Rio Grande Embayment, Texas, and implied history*, Am. Assoc. Petrol. Geol., Bull., vol. 14, pp. 1425-1437, 1 text fig.
- Hill, Robert T.** (1891) *Preliminary notes on the topography and geology of northern Mexico and south-west Texas, and New Mexico*, Am. Geol., vol. 8, pp. 133-141, 2 figs.
- (1892) *The geologic evolution of the non-mountainous topography of the Texas region. An introduction to the study of the Great Plains*, Am. Geol., vol. 10, pp. 105-115.



- Hill, Robert T.** (April, 1908) *Growth and decay of the Mexican Plateau*, Eng. Min. Jour., vol. 85, no. 14, pp. 681-688.
- Jones, Richard A.** (1925) *A reconnaissance study of the Salado Arch, Nuevo León, and Tamaulipas, Mexico*, Am. Assoc. Petrol. Geol., Bull., vol. 9, pp. 123-133, fig. 1 (sketch map).
- Kane, William G.** (1936) *Structural geology of Border Province of northeastern Mexico adjacent to Zapata and Starr counties, Texas*, Am. Assoc. Petrol. Geol., Bull., vol. 20, no. 4, pp. 403-416, 2 figs.
- Kane, William G., and Gierhart, Guy B.** (1935) *Areal geology of Eocene in northeastern Mexico*, Am. Assoc. Petrol. Geol., Bull., vol. 19, pp. 1357-1388, 4 figs.
- Kellum, Lewis Burnett** (1931) *Structure of the San Carlos Mountains, Mexico*, Geol. Soc. Am., Bull., vol. 42, pp. 230-231.
- (1937) *Geology of the sedimentary rocks of the San Carlos Mountains*, in *The Geology and Biology of the San Carlos Mountains, Tamaulipas, Mexico*, Rept. Univ. Mich. Exped. to San Carlos Mountains in 1930 (directed by Lewis Burnett Kellum), pp. 1-99; pls. 1-9; 5 text figs; maps 2-7.
- (1944) *Geologic history of northern Mexico and its bearing on petroleum exploration*, Am. Assoc. Petrol. Geol., Bull., vol. 28, pp. 301-325; figs. 1-10.
- King, Philip B.** (1942) *Tectonics of Northern Mexico*, 8th Am. Sci. Cong., Pr., vol. 4, pp. 395-398, pl. 1.
- Lonsdale, John T., and Day, James R.** (1937) *Geology and ground-water resources of Webb County, Texas*, U. S. Geol. Survey, Water-Supply Paper 778, pp. i-v; 1-104, pls. 1-12; text figs. 1-6, 1 chart.
- Muir, John M.** (1936) *Geology of the Tampico Region, Mexico*, Am. Assoc. Petrol. Geol., Tulsa, Okla., pp. i-xix; 1-280, figs. 1-40, pls. I-XV, tables I-IX. Some comparative references made to northeastern Mexico.
- Plummer, F. B.** (1933) *The geology of Texas, vol. 1, Part 3, Cenozoic systems in Texas*, Texas Univ. Bull. 3232, pp. 519-818, figs. 28-54, pls. 7-10.
- Prieto, Alejandro** (1873) *Historia, geografía y estadística del Estado de Tamaulipas, Mexico*, 361 pages, 14 pls.
- San Antonio Geological Society (1936) *Geologic road log of Pan-American highway, Laredo to Mexico City*, Am. Assoc. Petrol. Geol., Bull., vol. 20, pp. 456-466, 2 maps.
- (1936) *Geologic road log in Tamaulipas and Nuevo León, Mexico*, Am. Assoc. Petrol. Geol., Bull., vol. 20, pp. 467-477, 1 fig.
- Schott, Arthur** (1857) *Substance of the sketch of the geology of the lower Rio Bravo del Norte*, in Emory, William H., *Report on the United States and Mexican Boundary Survey*, U. S., 34th Cong., 1st sess., Senate Ex. Doc. 108 and House Ex. Doc. 135, vol. 1, pt. 2, pp. 28-48, 2 text illustrations.
- Schuchert, Charles** (1935) *Historical geology of the Antillean-Caribbean region*, pp. i-xxvi, 1-811, pls. 1-16, figs. 1-107, John Wiley & Sons, Inc., New York City.
- Sellards, E. H., and Baker, C. L.** (1934) *Geology of Texas, vol. 2, Structural and economic geology*, Univ. Texas Bull. 3401, pp. 1-884, figs. 1-40, pls. 1-8.
- Staub, Walther** (1931) *Zur Entstehungsgeschichte des Golfes von Mexiko*; Eclogae geol. Helvetiae, vol. 24, pp. 61-83, 1 table, 6 maps.
- (1933) *Die Strasse von Florida, ein ertrunkenes Flusstal*, Gesell. Erdkunde Berlin Zeitschr., Heft 5-6, pp. 216-218.
- Stenzel, H. B.** (1940) *New zone in Cook Mountain formation, The Crassatella texalta Harris-Turritella cortezi Bowles zone*, Am. Assoc. Petrol. Geol., Bull., vol. 24, pp. 1663-1675, 3 figs.
- Stephenson, Lloyd W.** (1928) *Structural features of the Atlantic and Gulf Coastal Plain*, Geol. Soc. Am., Bull., vol. 39, no. 4, pp. 887-899, 1 text fig.
- Tatum, J. L.** (1928) *Cretaceous and Tertiary of southern Texas and northern Mexico* (Univ. Texas Bull. 2748); *Discussion of*, Am. Assoc. Petrol. Geol., Bull., vol. 12, pp. 949-950.
- (Aug., 1931) *General geology of northeast Mexico*, Am. Assoc. Petrol. Geol., Bull., vol. 15, pp. 867-893, fig. 1.
- (Aug. 7, 1931) *General geology of northeast Mexico*, Oil Weekly Jour., vol. 62, no. 8, pp. 21-32, 78-80, 1 map.



- Tatum, J. L.** (June 10, 1935) *Geology and exploration in northeastern Mexico*, Oil Weekly Jour., vol. 77, no. 13, pp. 35-40, 1 map.
- Thayer, Warren N.** (1916) *The physiography of Mexico*, Jour. Geol., vol. 24, pp. 61-94, 2 text figs.
- Trowbridge, A. C.** (1932) *Tertiary and Quaternary geology of the lower Rio Grande region, Texas*, U. S. Geol. Survey, Bull. 837, pp. i-viii, 1-260, pls. 1-45, 76 figs.
- Vaughan, Thomas Wayland** (Dec., 1918) *Geologic history of Central America and the West Indies during Cenozoic time*, Geol. Soc. Am., Bull., vol. 29, pp. 615-630, 2 charts.
- (1924a) *Recent additions to knowledge of the correlation of the Tertiary geologic formations of northeastern Mexico, Central America, the West Indies, northern South America, and Lower California*, Pan-Pacific Sci. Cong., Australian meeting, 1923, Pr., vol. 1, pp. 864-870.
- (Dec., 1924b) *Criteria and status of correlation and classification of Tertiary deposits*, Geol. Soc. Am., Bull., vol. 35, pp. 677-742, 2 correlation tables.
- Ver Wiebe, Walter A.** (1924) *The stratigraphy of the petroliferous area of eastern Mexico*, Am. Jour. Sci., 5th ser., vol. 8, Part 1, pp. 277-295; Part 2, pp. 385-394; Part 3, pp. 481-502.



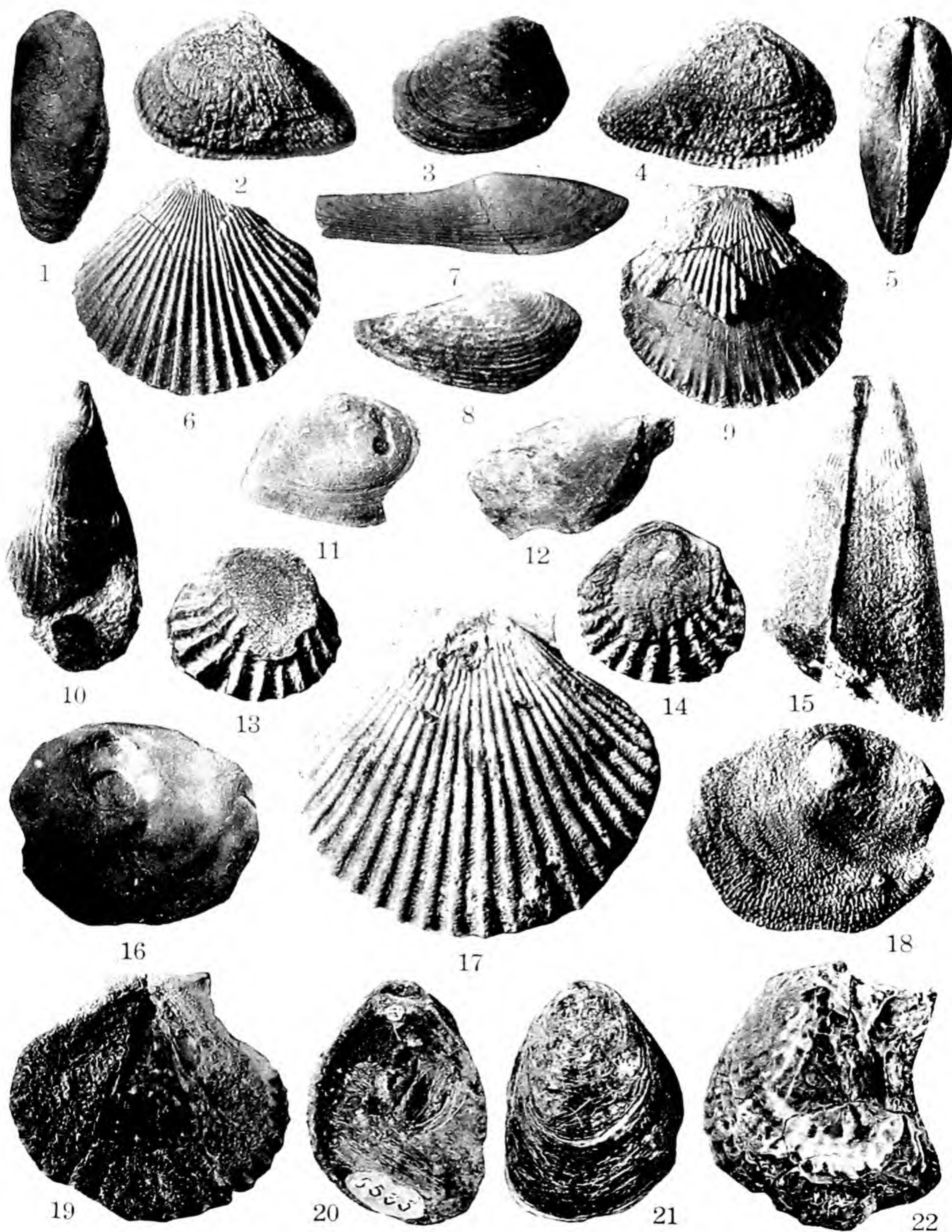
EXPLANATION OF PLATES



## PLATE 1.—TERTIARY MOLLUSCA

Figures		Page
1.	<i>Lithophaga</i> sp.....	58
	Exterior of left valve (U. S. Nat. Mus. 495925). × 2.	
2.	<i>Halonanus pulchrus</i> (Gabb)?.....	51
	Exterior of left valve (U. S. Nat. Mus. 496022). × 3.	
3.	<i>Nucula spheniopsis</i> Conrad.....	42
	Exterior of left valve (U. S. Nat. Mus. 495920). × 2.	
4.	<i>Halonanus pulchrus</i> (Gabb)?.....	51
	Exterior of right valve (U. S. Nat. Mus. 496022). × 3.	
5.	<i>Lithophaga</i> sp.....	58
	Dorsal view of double valves (U. S. Nat. Mus. 495925). × 2.	
6.	<i>Chlamys capa</i> Gardner, n. sp.....	65
	Exterior of cotype, a left valve (U. S. Nat. Mus. 496267). × 2.	
7.	<i>Calorhadia</i> ( <i>Litorhadia</i> ) <i>lisbonensis</i> (Aldrich).....	48
	Exterior of topotype, a right valve (U. S. Nat. Mus. 495052). × 1.	
8.	<i>Calorhadia</i> ( <i>Litorhadia</i> ) sp.....	47
	Exterior of right valve (U. S. Nat. Mus. 495922). × 5.	
9.	<i>Chlamys capa</i> Gardner, n. sp.....	65
	Exterior of cotype, a right valve (U. S. Nat. Mus. 496267). × 2.	
10.	<i>Atrina jacksoniana</i> Dall?.....	61
	Exterior of right valve (U. S. Nat. Mus. 495931). × 1.	
11.	<i>Halonanus declivis</i> (Conrad)?.....	52
	Exterior of right valve (U. S. Nat. Mus. 495923). × 3.	
12.	<i>Pteria limula</i> (Conrad)?.....	59
	Exterior of right valve (U. S. Nat. Mus. 495926). × 1.	
13-14.	<i>Plicatula euplecta</i> Gardner, n. sp.....	71
	Holotype, a pair of locked valves (U. S. Nat. Mus. 495930).	
	13. Exterior of right valve. × 2.	
	14. Exterior of left valve. × 2.	
15.	<i>Atrina jacksoniana</i> Dall?.....	61
	Dorsal view of double valves (U. S. Nat. Mus. 495931). × 1.	
16.	<i>Anomia ephippioides</i> Gabb.....	73
	Interior of left valve (U. S. Nat. Mus. 495021). × 1½.	
17.	<i>Chlamys capa jouda</i> Gardner, n. subsp.....	66
	Exterior of holotype, a right valve (U. S. Nat. Mus. 496024). × 3.	
18.	<i>Anomia ephippioides</i> Gabb.....	73
	Exterior of left valve (U. S. Nat. Mus. 495021). × 1½.	
19.	<i>Chlamys</i> sp. cf. <i>C. nupera</i> (Conrad).....	66
	Interior of right valve (U. S. Nat. Mus. 494974). × 1½.	
20-22.	<i>Ostrea lisbonensis</i> Harris.....	79
	20, 21. Interior and exterior of right valve (U. S. Nat. Mus. 495997). × 1.	
	22. Exterior of left valve (U. S. Nat. Mus. 495998). × 1.	





TERTIARY MOLLUSCA





TERTIARY MOLLUSCA



## PLATE 2.—TERTIARY MOLLUSCA

Figures		Page
1-4.	<i>Ostrea gierharti</i> Gardner, n. sp.....	78
1.	Exterior of left cotype (U. S. Nat. Mus. 372916). × 1.	
2.	Interior of left cotype. × 1.	
3.	Profile of left cotype. × 1.	
4.	Exterior of right cotype (U. S. Nat. Mus. 372916). × 1.	
5.	<i>Ostrea</i> sp.....	83
	Exterior of left valve (U. S. Nat. Mus. 499278). × 1.	
6.	<i>Ostrea semmesi</i> Gardner, n. sp.....	78
	Interior of right cotype (U. S. Nat. Mus. 372917). × 1.	
7.	<i>Ostrea frithi</i> Gardner, n. sp.....	82
	Interior of holotype, a left valve (U. S. Nat. Mus. 372918). × 1.	
8.	<i>Ostrea semmesi</i> Gardner, n. sp.....	78
	Interior of left cotype (U. S. Nat. Mus. 372917). × 1.	
9.	<i>Ostrea frithi</i> Gardner, n. sp.....	82
	Profile of holotype shown in Figure 7. × 1.	



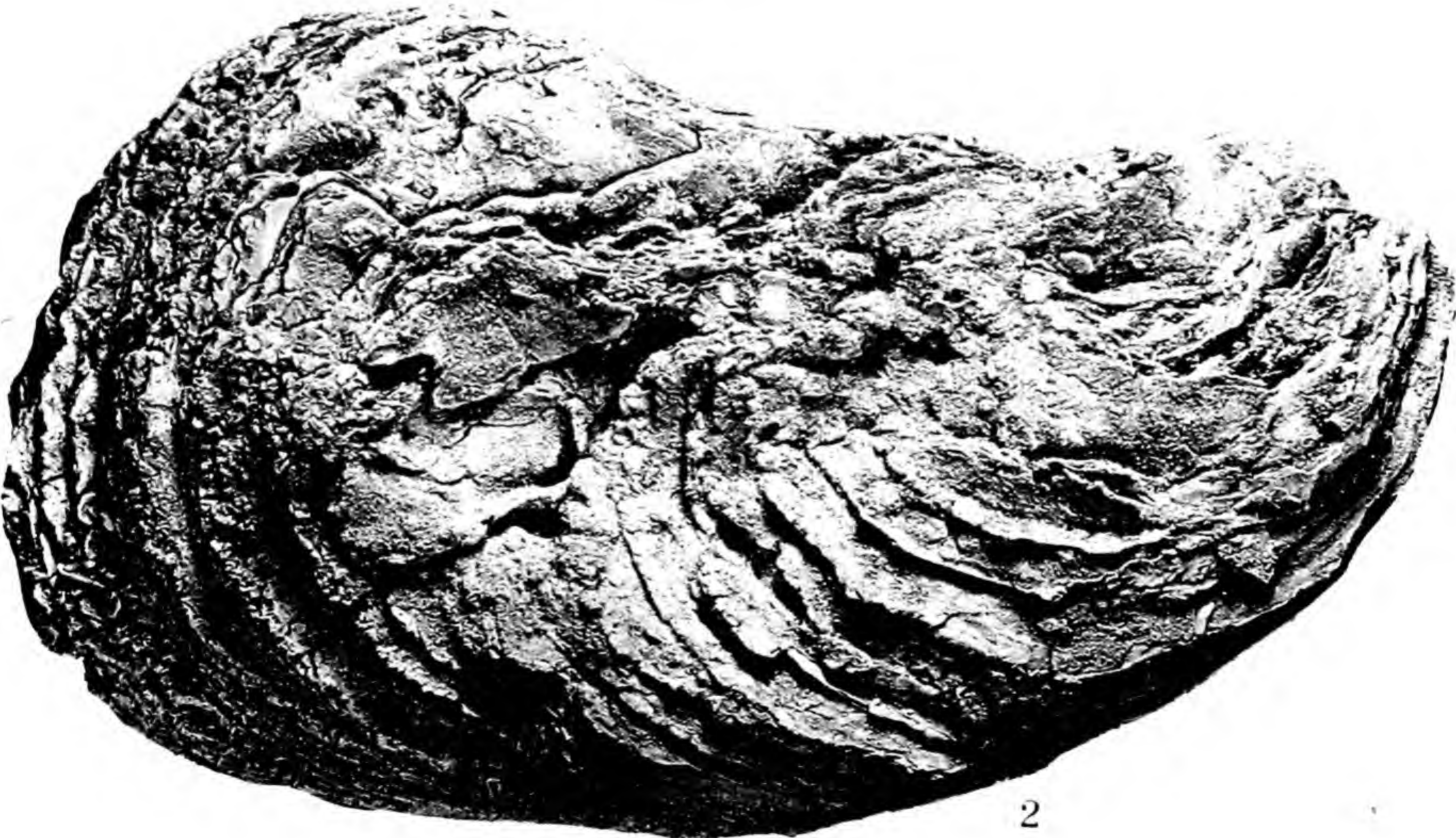
PLATE 3.—TERTIARY MOLLUSCA

Figures	Page
1-2. <i>Ostrea contracta amichel</i> Gardner, n. subsp.....	81
1. Interior of left cotype (U. S. Nat. Mus. 496573). × 1.	
2. Exterior of right cotype (U. S. Nat. Mus. 496573). × 1.	





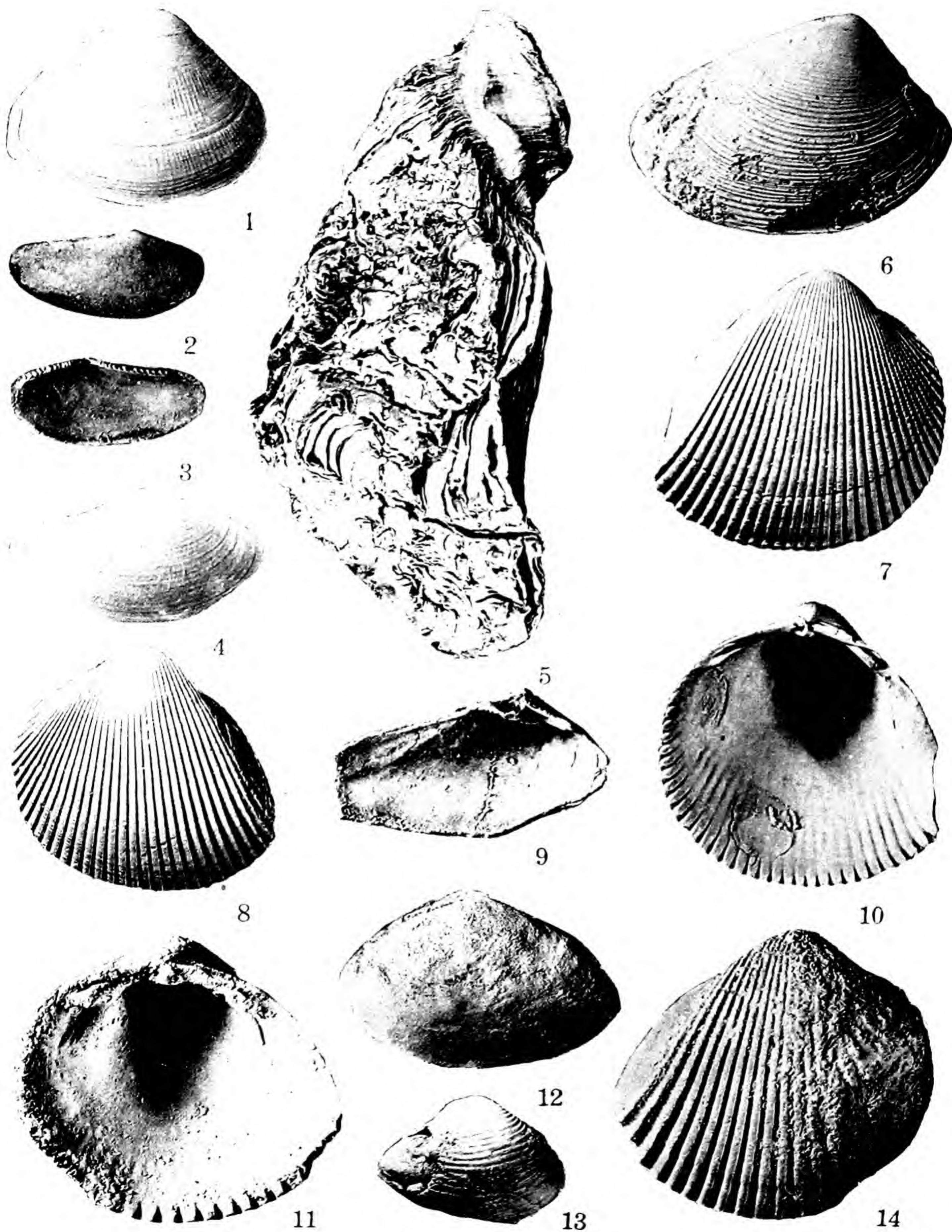
1



2

TERTIARY MOLLUSCA





TERTIARY MOLLUSCA



## PLATE 4.—TERTIARY MOLLUSCA

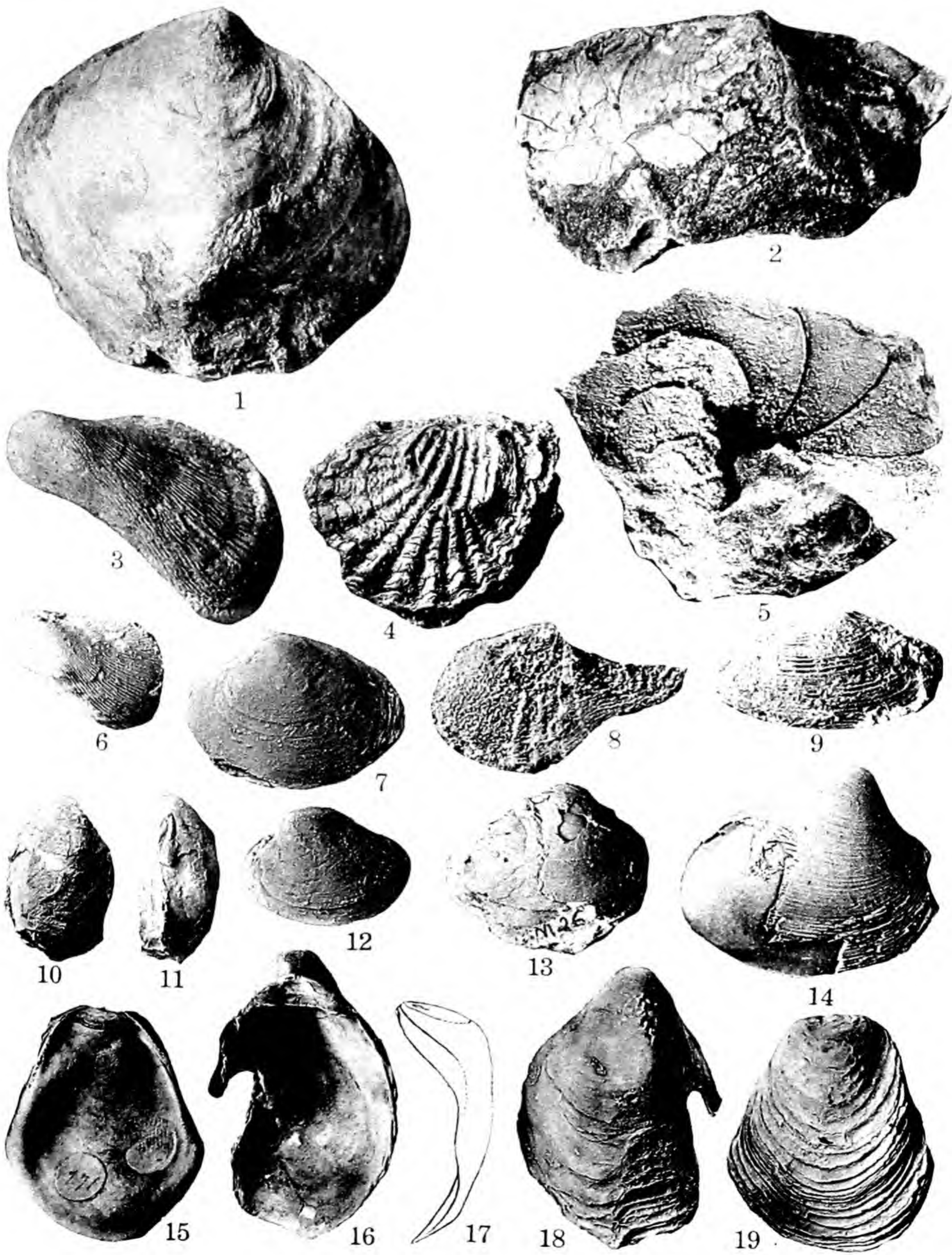
Figures		Page
1.	<i>Corbula</i> ( <i>Caryocorbula</i> ) <i>coloradoensis</i> Gardner.....	132
	Exterior of paratype, a right valve (U. S. Nat. Mus. 370992). × 6.	
2-3.	<i>Orthoyoldia psammotaea</i> (Dall).....	50
	2. Exterior of right valve (U. S. Nat. Mus. 559400). × 3.	
	3. Interior of right valve shown in Figure 2. × 3.	
4.	<i>Ledina smirna</i> Dall.....	44
	Exterior of right valve, possibly a topotype (U. S. Nat. Mus. 155133). × 2.	
5.	<i>Ostrea</i> sp.....	83
	Profile of left valve (U. S. Nat. Mus. 499278). × 1.	
6.	<i>Callocardia pteleina</i> Gardner.....	116
	Exterior of holotype, a right valve (U. S. Nat. Mus. 370921). × 2. (After Gardner.)	
7-8.	<i>Cerastoderma</i> ( <i>Dinocardium</i> ) <i>cabezai</i> Gardner, n. sp.....	102
	7. Exterior of right cotype (U. S. Nat. Mus. 495176). × 1.	
	8. Exterior of left cotype (U. S. Nat. Mus. 495176). × 1.	
9.	<i>Corbula</i> ( <i>Erodona</i> ?) <i>carlotae</i> Gardner, n. sp.....	137
	Interior of imperfect paratype, a left valve (U. S. Nat. Mus. 496263). × 2½.	
10.	<i>Cerastoderma</i> ( <i>Dinocardium</i> ) <i>cabezai</i> Gardner, n. sp.....	102
	Interior of right cotype shown in Figure 7. × 1.	
11.	<i>Cerastoderma</i> ( <i>Dinocardium</i> ) <i>bakeri</i> Gardner, n. sp.....	101
	Interior of holotype, a right valve (U. S. Nat. Mus. 497159). × 3.	
12.	<i>Tellina santander</i> Gardner, n. sp.....	105
	Holotype, a mold of the interior of the left valve (U. S. Nat. Mus. 352271). × 1.	
13.	<i>Corbula</i> ( <i>Varicorbula</i> ) <i>azucar</i> Gardner, n. sp.....	131
	Exterior of holotype, a right valve (U. S. Nat. Mus. 496465). × 2.	
14.	<i>Cerastoderma</i> ( <i>Dinocardium</i> ) <i>bakeri</i> Gardner, n. sp.....	101
	Exterior of holotype shown in Figure 11. × 3.	



## PLATE 5

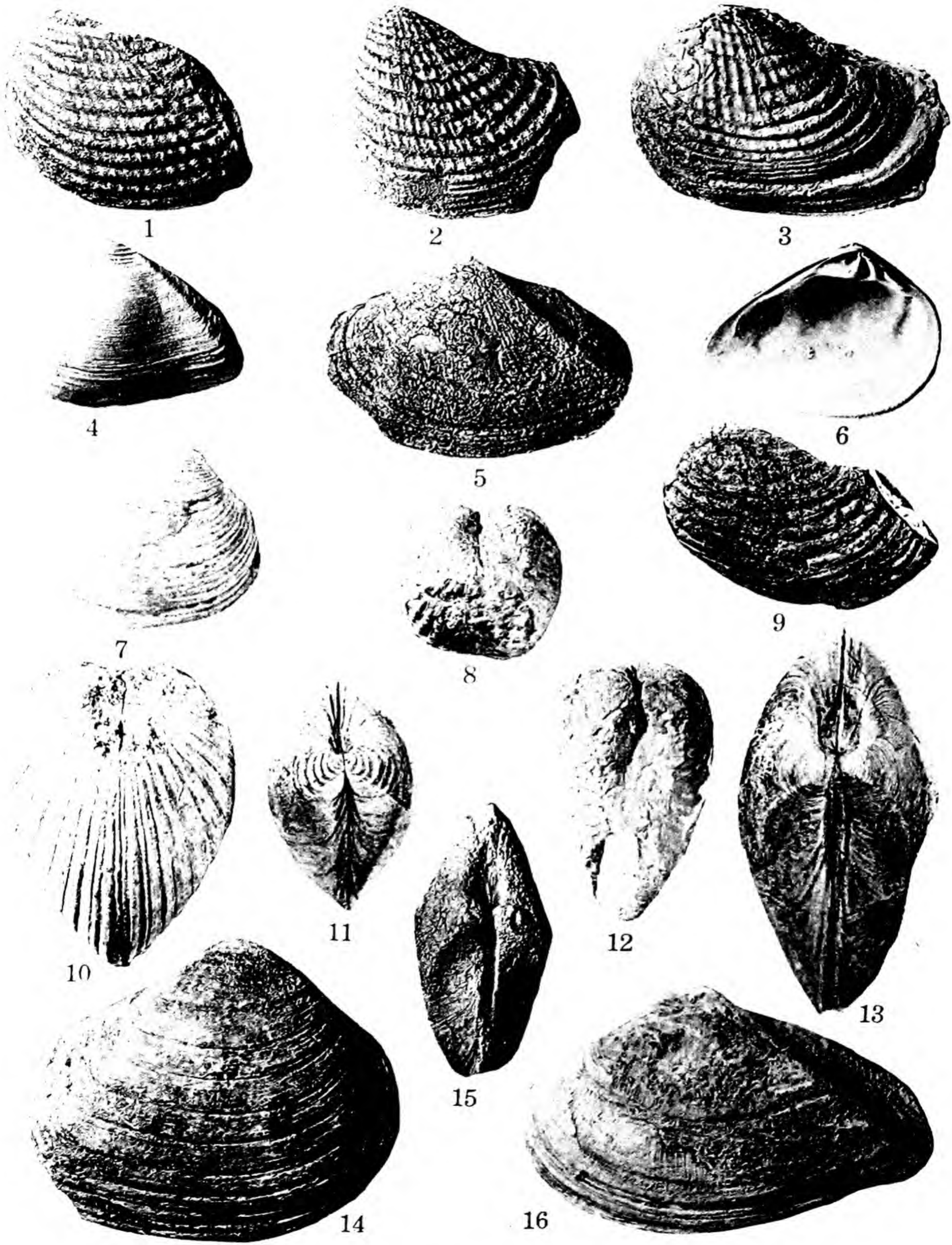
Figures	Page
1-2. <i>Anomia malinchae</i> Gardner, n. sp.....	72
1. Exterior of holotype, a left valve (U. S. Nat. Mus. 494959). × 1.	
2. Exterior of imperfect paratype, a left valve (U. S. Nat. Mus. 494960). × 1.	
3. <i>Musculus carlotae</i> Gardner, n. sp.....	57
Impression from holotype, a left valve (U. S. Nat. Mus. 494975). × 3.	
4. <i>Plicatula lalajensis</i> Gardner, n. sp.....	70
Exterior of holotype, a right valve (U. S. Nat. Mus. 495046). × 2.	
5. <i>Hercoglossa</i> sp. cf. <i>H. vauhani</i> Gardner.....	268
Fragment (U. S. Nat. Mus. 494962). × 1.	
6. <i>Musculus carlotae</i> Gardner, n. sp.....	57
Exterior of paratype, a left valve (U. S. Nat. Mus. 494968). × 3.	
7. <i>Callocardia</i> ( <i>Agriopoma</i> ?) sp. cf. <i>C. pteleina</i> Gardner.....	116
Exterior of left valve (U. S. Nat. Mus. 494977). × 3.	
8. <i>Cuspidaria</i> ( <i>Cardiomya</i> ) <i>vieja</i> Gardner, n. sp.....	88
Exterior of holotype, a left valve (U. S. Nat. Mus. 495017). × 10.	
9. <i>Calorhadia</i> ( <i>Litorhadia</i> ) <i>santa-anai</i> Gardner, n. sp.....	45
Exterior of holotype, a right valve (U. S. Nat. Mus. 495047). × 3.	
10-11. <i>Ostrea eothirsa</i> Gardner, n. sp.....	75
10. Exterior of holotype, a left valve (U. S. Nat. Mus. 559392). × 1½.	
11. Profile of holotype. × 1½.	
12-13. <i>Callocardia</i> ( <i>Agriopoma</i> ?) sp. cf. <i>C. pteleina</i> Gardner.....	116
12. Exterior of left valve (U. S. Nat. Mus. 494977). × 3.	
13. Exterior of right valve (U. S. Nat. Mus. 495004). × 1.	
14. <i>Incertae sedis</i> .....	121
Exterior of right valve (U. S. Nat. Mus. 495005). × 3.	
15-19. <i>Ostrea thirsa</i> (Gabb).....	76
15. Interior of topotype, a right valve (U. S. Nat. Mus. 494964). × 1.	
16. Interior of holotype, a left valve (U. S. Nat. Mus. 494957). × 1.	
17. Profile of topotype, a right valve (U. S. Nat. Mus. 494964). × 1.	
18. Exterior of holotype, a left valve (U. S. Nat. Mus. 494957). × 1.	
19. Exterior of topotype, a right valve (U. S. Nat. Mus. 494964). × 1.	





TERTIARY MOLLUSCA







## PLATE 6.—TERTIARY MOLLUSCA

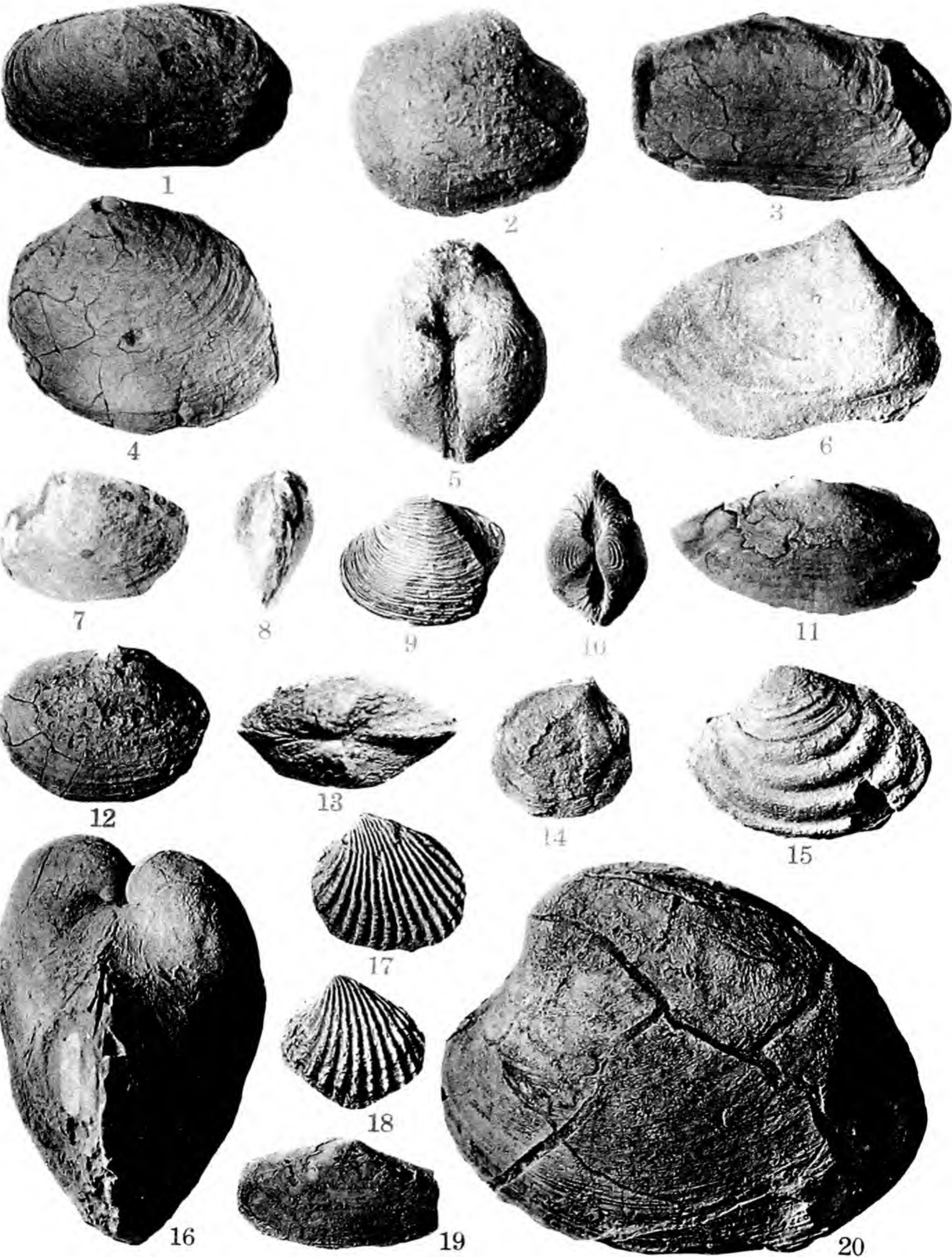
Figures		Page
1-3.	<i>Pholadomya claibornensis harrisi</i> Gardner.....	86
1.	Exterior of left valve (U. S. Nat. Mus. 496116). $\times 1\frac{1}{2}$ .	
2.	Exterior of left valve (U. S. Nat. Mus. 496261). $\times 1\frac{1}{2}$ .	
3.	Exterior of left valve (U. S. Nat. Mus. 496115). $\times 1\frac{1}{2}$ .	
4.	<i>Crassatellites tumidulus</i> (Whitfield).....	91
	Exterior of holotype, a left valve (Walker Museum, Univ. of Chicago, 24476). $\times 1\frac{1}{2}$ .	
5.	<i>Crassatellites clarkensis</i> Dall.....	92
	Exterior of left valve (U. S. Nat. Mus. 496002). $\times 2$ .	
6.	<i>Crassatellites tumidulus</i> (Whitfield).....	91
	Interior of holotype shown in Figure 4. $\times 1\frac{1}{2}$ .	
7.	<i>Crassatellites antestriatus</i> (Gabb).....	90
	Exterior of right valve (U. S. Nat. Mus. 494952). $\times 2$ .	
8-9.	<i>Pholadomya claibornensis harrisi</i> Gardner.....	86
8.	Front view of double valves (U. S. Nat. Mus. 496114). $\times 1$ .	
9.	Exterior of left valve (U. S. Nat. Mus. 496114). $\times 1$ .	
10-11.	<i>Crassatellites antestriatus</i> (Gabb).....	90
10.	Front view of double valves (U. S. Nat. Mus. 497101). $\times 1$ .	
11.	Dorsal view of double valves (U. S. Nat. Mus. 494952). $\times 2$ .	
12.	<i>Pholadomya claibornensis harrisi</i> Gardner.....	86
	Dorsal view of double valves (U. S. Nat. Mus. 496114). $\times 1$ .	
13.	<i>Crassatellites clarkensis</i> Dall.....	92
	Dorsal view of double valves (U. S. Nat. Mus. 496001). $\times 2$ .	
14.	<i>Crassatellites antestriatus</i> (Gabb).....	90
	Exterior of right valve (U. S. Nat. Mus. 497101). $\times 1$ .	
15-16.	<i>Crassatellites clarkensis</i> Dall.....	92
15.	Dorsal view of double valves (U. S. Nat. Mus. 496002). $\times 2$ .	
16.	Exterior of left valve (U. S. Nat. Mus. 496001). $\times 2$ .	



## PLATE 7.—TERTIARY MOLLUSCA

Figures	Page
1. <i>Gari</i> sp. cf. <i>G. eborea</i> Conrad.....	109
Exterior of left valve (U. S. Nat. Mus. 496118). $\times 1\frac{1}{2}$ .	
2. <i>Diplodonta</i> ( <i>Sphaerella</i> ) <i>anteproducta</i> Harris.....	98
Exterior of right valve (U. S. Nat. Mus. 496266). $\times 2$ .	
3. <i>Gari</i> sp. cf. <i>G. eborea</i> Conrad.....	109
Exterior of left valve (U. S. Nat. Mus. 496119). $\times 1\frac{1}{2}$ .	
4. <i>Incertae sedis</i> .....	109
Exterior of left ? valve (U. S. Nat. Mus. 496272). $\times 1\frac{1}{2}$ .	
5. <i>Diplodonta</i> ( <i>Sphaerella</i> ) <i>anteproducta</i> Harris.....	98
Dorsal view of double valves (U. S. Nat. Mus. 496266). $\times 2$ .	
6. <i>Mesodesma singleyi</i> (Harris).....	114
Exterior of mold of left valve (U. S. Nat. Mus. 496339). $\times 1$ .	
7-8. <i>Thracia?</i> sp.....	87
7. Exterior of right valve (U. S. Nat. Mus. 495999). $\times 1$ .	
8. Front view of double valves (U. S. Nat. Mus. 495999). $\times 1$ .	
9-10. <i>Crassatellites antestriatus</i> (Gabb).....	90
9. Exterior of left valve (U. S. Nat. Mus. 496264). $\times 1$ .	
10. Dorsal view of double valves (U. S. Nat. Mus. 496264). $\times 1$ .	
11. <i>Tellina</i> ( <i>Tellinella?</i> ) sp.....	107
Mold of right valve (U. S. Nat. Mus. 496117). $\times 1$ .	
12. <i>Incertae sedis</i> .....	109
Exterior of right ? valve (U. S. Nat. Mus. 496273). $\times 1$ .	
13. <i>Halonanus pulchrus</i> (Gabb)?.....	51
Dorsal view of double valves (U. S. Nat. Mus. 496022). $\times 3$ .	
14. <i>Phacoides quintamaia</i> Gardner, n. sp.....	95
Exterior of right valve of holotype (U. S. Nat. Mus. 496028). $\times 1$ .	
15. <i>Incertae sedis</i> .....	89
Exterior of left valve (U. S. Nat. Mus. 496000). $\times 2$ .	
16. <i>Callocardia</i> ( <i>Agriopoma</i> ) sp.....	118
Front view of double valves (U. S. Nat. Mus. 496348). $\times 1$ .	
17-18. Group of <i>Venericardia rotunda</i> Isaac Lea.....	93
17. Exterior of left valve (U. S. Nat. Mus. 496025). $\times 1\frac{1}{2}$ .	
18. Exterior of left valve (U. S. Nat. Mus. 496265). $\times 1$ .	
19. <i>Tellina</i> ( <i>Tellinella?</i> ) sp.....	107
Exterior of left valve (U. S. Nat. Mus. 496334). $\times 1$ .	
20. <i>Callocardia</i> ( <i>Agriopoma</i> ) sp.....	118
Exterior of left valve (U. S. Nat. Mus. 496348). $\times 1$ .	





TERTIARY MOLLUSCA





1



2



3



4



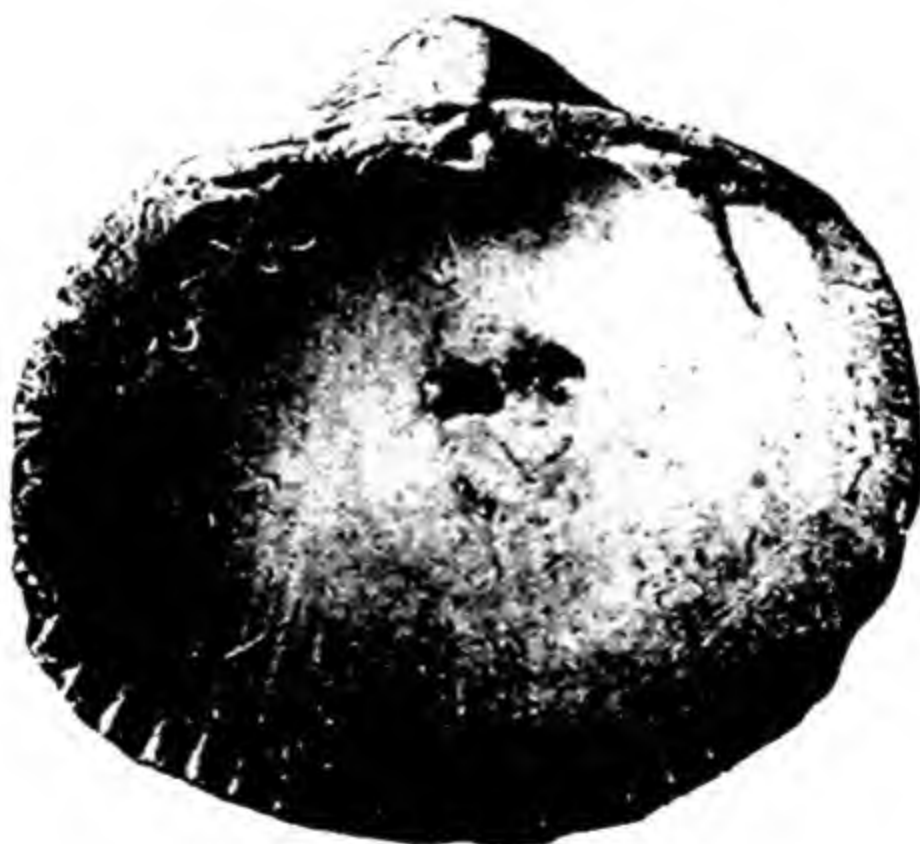
5



6



7



8



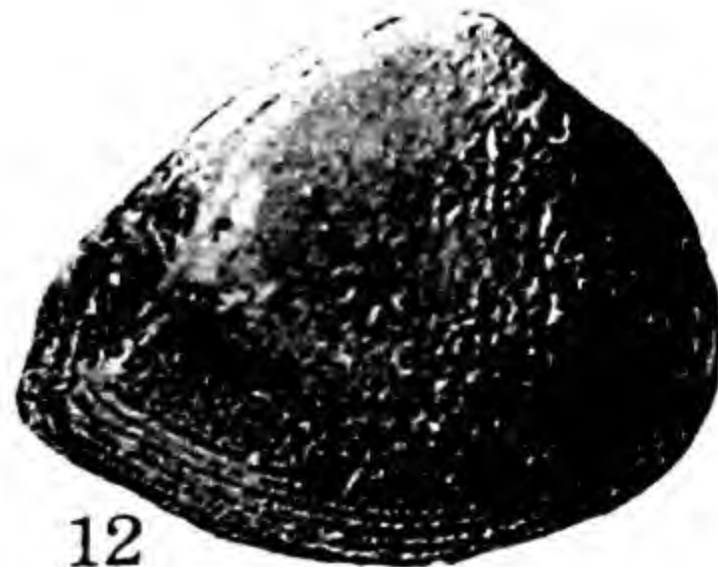
9



10



11



12



## PLATE 8.—TERTIARY MOLLUSCA

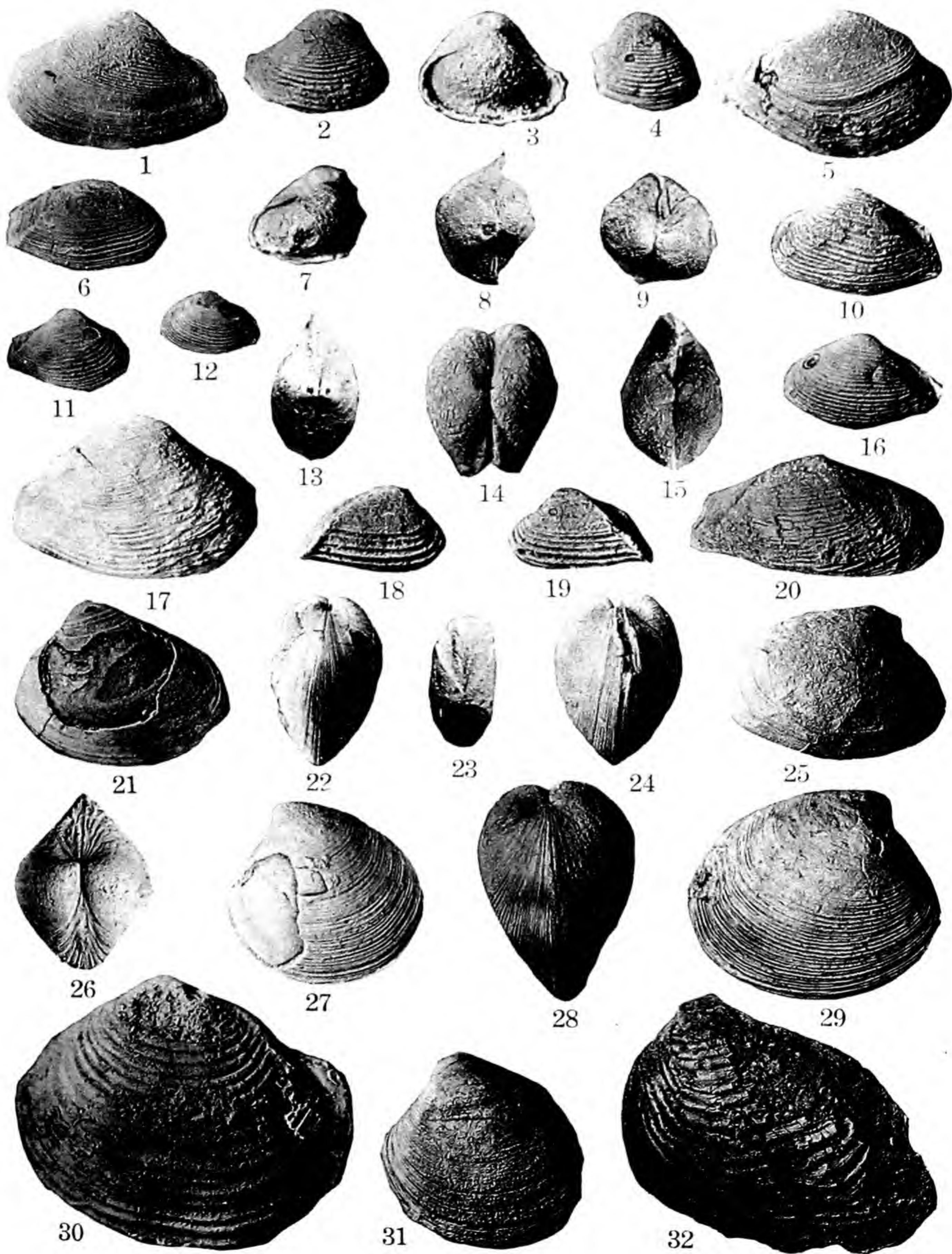
Figures	Page
1-3. <i>Cerastoderma carlotae</i> Gardner, n. sp.....	100
1. Exterior of left cotype (U. S. Nat. Mus. 494966). $\times 1\frac{1}{2}$ .	
2. Interior of left cotype shown in Figure 1. $\times 1\frac{1}{2}$ .	
3. Exterior of right cotype (U. S. Nat. Mus. 494966). $\times 1\frac{1}{2}$ .	
4. <i>Cerastoderma tuomeyi</i> (Aldrich).....	100
Interior of right cotype (Johns Hopkins Univ. Coll.). $\times 1$ .	
5-6. <i>Cerastoderma</i> sp.....	100
5. Sculpture detail from medial portion of shell (U. S. Nat. Mus. 494976). $\times 10$ .	
6. Exterior of incomplete left valve (U. S. Nat. Mus. 494976). $\times 1$ .	
7-9. <i>Cerastoderma tuomeyi</i> (Aldrich).....	100
7. Exterior of right cotype shown in Figure 4. $\times 1$ .	
8. Interior of left cotype (Johns Hopkins Univ. Coll.). $\times 1$ .	
9. Exterior of left cotype shown in Figure 8. $\times 1$ .	
10. <i>Jouannetia francesae</i> Gardner, n. sp.....	139
Exterior of holotype, a right valve (U. S. Nat. Mus. 496033). $\times 4$ .	
11. Pholad, gen. and sp. ind.....	139
Exterior of right valve (U. S. Nat. Mus. 494967). $\times 2\frac{1}{2}$ .	
12. <i>Corbula</i> ( <i>Caryocorbula</i> ) <i>aldrichi</i> Meyer?.....	132
Exterior of right valve (U. S. Nat. Mus. 496026). $\times 6$ .	



## PLATE 9.—TERTIARY MOLLUSCA

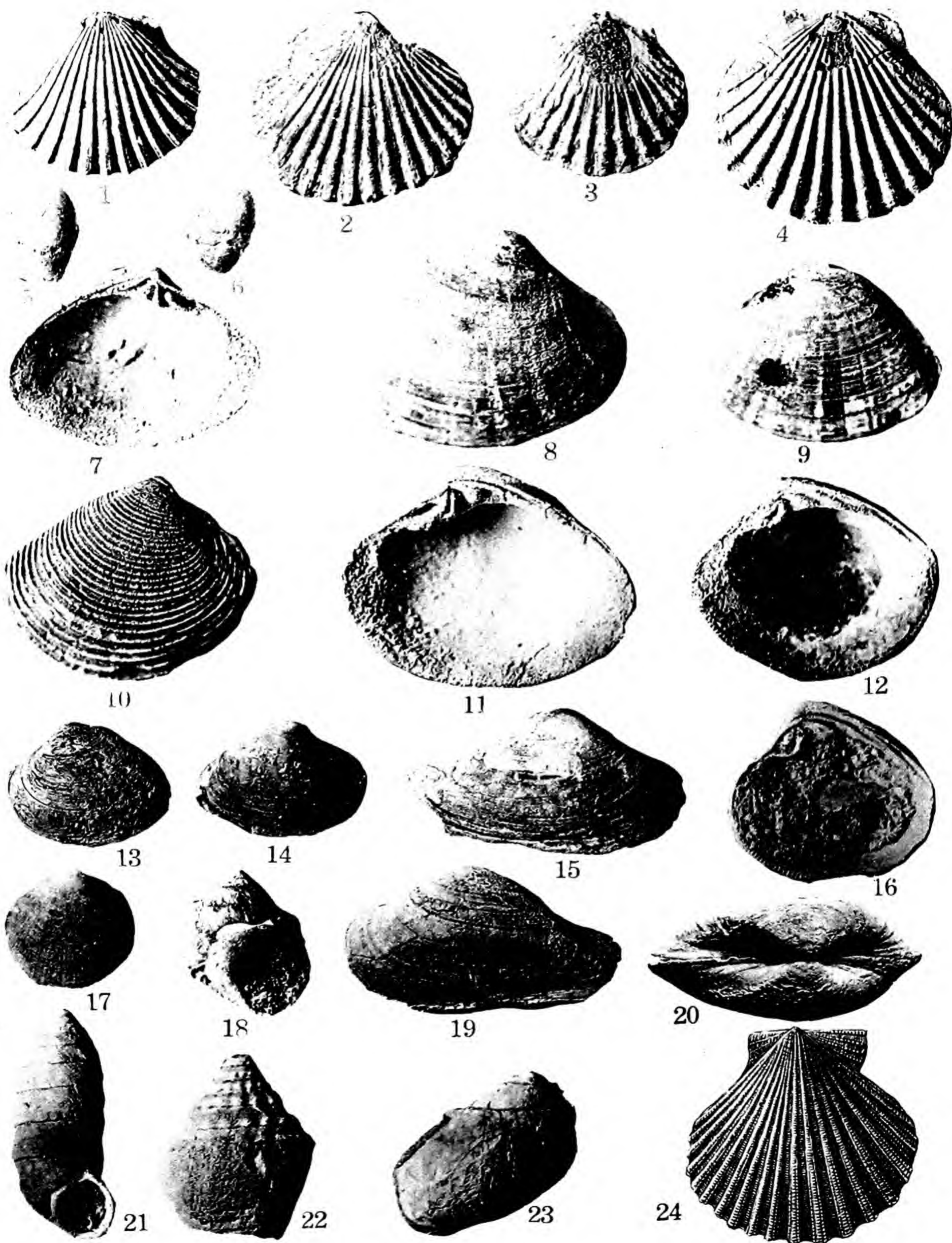
Figures	Page
1. <i>Corbula (Varicorbula) texana</i> Gabb?.....	127
Exterior of left valve (U. S. Nat. Mus. 496270). $\times 3$ .	
2-4. <i>Corbula (Varicorbula) smithvillensis</i> Harris.....	128
2. Exterior of right valve (U. S. Nat. Mus. 496268). $\times 2\frac{1}{2}$ .	
3. Exterior of left valve with overtopping right valve shown in Figure 2. $\times 2\frac{1}{2}$ .	
4. Exterior of right valve (U. S. Nat. Mus. 496269). $\times 2\frac{1}{2}$ .	
5. <i>Corbula (Varicorbula) texana</i> Gabb?.....	127
Exterior of right valve (U. S. Nat. Mus. 495027). $\times 2\frac{1}{2}$ .	
6. <i>Corbula (Caryocorbula)</i> sp. cf. <i>C. (Caryocorbula) engonata</i> Conrad.....	135
Exterior of right valve (U. S. Nat. Mus. 496347). $\times 2\frac{1}{2}$ .	
7-9. <i>Corbula (Varicorbula) smithvillensis</i> Harris.....	128
7. Exterior of left valve with overtopping right valve shown in Figure 4. $\times 2\frac{1}{2}$ .	
8. Dorsal view of double valves shown in Figures 2 and 3. $\times 2\frac{1}{2}$ .	
9. Dorsal view of double valves shown in Figures 4 and 7. $\times 2\frac{1}{2}$ .	
10. <i>Corbula (Caryocorbula) carli</i> Gardner, n. sp.....	136
Exterior of left valve of holotype (U. S. Nat. Mus. 496346). $\times 2\frac{1}{2}$ .	
11-12. <i>Corbula (Varicorbula) gregorioi</i> Cossmann?.....	129
11. Exterior of right valve (U. S. Nat. Mus. 496340). $\times 3$ .	
12. Exterior of left valve of another individual (U. S. Nat. Mus. 496340). $\times 3$ .	
13. <i>Corbula (Caryocorbula) conradi</i> Dall.....	133
Dorsal view of double valves (U. S. Nat. Mus. 496343). $\times 2\frac{1}{2}$ .	
14. <i>Corbula (Caryocorbula)</i> sp. cf. <i>C. (C) conradi</i> Dall.....	133
Dorsal view of double valves (U. S. Nat. Mus. 496345). $\times 2\frac{1}{2}$ .	
15. <i>Corbula (Caryocorbula) carli</i> Gardner, n. sp.....	136
Dorsal view of double valves of holotype (U. S. Nat. Mus. 496346). $\times 2\frac{1}{2}$ .	
16. <i>Corbula (Caryocorbula) conradi</i> Dall.....	133
Exterior of left valve (U. S. Nat. Mus. 496343). $\times 2\frac{1}{2}$ .	
17. <i>Corbula (Varicorbula)</i> sp.....	131
Exterior of right valve (U. S. Nat. Mus. 496341). $\times 2\frac{1}{2}$ .	
18-19. <i>Corbula (Caryocorbula) engonatoides</i> Gardner.....	134
18. Exterior of right valve (U. S. Nat. Mus. 496121). $\times 2\frac{1}{2}$ .	
19. Exterior of left valve of same individual. $\times 2\frac{1}{2}$ .	
20. <i>Corbula (Caryocorbula) santanensis</i> Gardner, n. sp.....	134
Exterior of holotype, a right valve (U. S. Nat. Mus. 496344). $\times 2\frac{1}{2}$ .	134
21-22. <i>Incertae sedis</i> .....	119
21. Exterior of left valve (U. S. Nat. Mus. 496441). $\times 2$ .	
22. Front view of double valves. $\times 2$ .	
23. <i>Corbula (Caryocorbula) engonatoides</i> Gardner.....	134
Dorsal view of double valves (U. S. Nat. Mus. 496121). $\times 2\frac{1}{2}$ .	
24-25. <i>Callocardia (Agriopoma) tornadonis</i> (Harris).....	117
24. Front view of double valves (U. S. Nat. Mus. 496038). $\times 1$ .	
25. Lateral view of right valve shown in Figure 24. $\times 1$ .	
26-29. <i>Callocardia (Agriopoma) amichel</i> Gardner, n. sp.....	116
26. Dorsal view of double valves of paratype (U. S. Nat. Mus. 559290). $\times 1$ .	
27. Lateral view of left valve shown in Figure 26. $\times 1$ .	
28. Front view of double valves of holotype. (U. S. Nat. Mus. 496021). $\times 1$ .	
29. Lateral view of right valve of holotype. $\times 1$ .	
30. <i>Incertae sedis</i> probably referable to <i>Pteropsis</i> .....	113
Exterior of left valve (U. S. Nat. Mus. 496274). $\times 2$ .	
31. <i>Callocardia (Agriopoma) amichel</i> Gardner, n. sp.....	116
Exterior of left valve (U. S. Nat. Mus. 496020). $\times 1$ .	
32. <i>Pteropsis lapidosa</i> Conrad.....	112
Exterior of left valve (U. S. Nat. Mus. 496271). $\times 1\frac{1}{2}$ .	





TERTIARY MOLLUSCA







## PLATE 10.—TERTIARY MOLLUSCA

Figures	Page
1-4. <i>Pecten (Pecten) byramensis</i> Gardner, n. sp.?	62
1. Exterior of right valve (U. S. Nat. Mus. 495927). $\times 1$ .	
2. Exterior of left valve (U. S. Nat. Mus. 495928). $\times 1\frac{1}{2}$ .	
3. Exterior of smaller left valve (U. S. Nat. Mus. 495928). $\times 1\frac{1}{2}$ .	
4. Exterior of left valve (U. S. Nat. Mus. 495927). $\times 1$ .	
5-6. <i>Celliforma?</i> sp.	269
5. Lateral view of incomplete tube (U. S. Nat. Mus. 495924). $\times 1$ .	
6. View of larger end of incomplete tube shown in Figure 5. $\times 1$ .	
7-9. <i>Macrocallista (Chionella) cantui</i> Gardner, n. sp.	115
7. Interior of left cotyle (U. S. Nat. Mus. 496335). $\times 2\frac{1}{2}$ .	
8. Exterior of right cotyle (U. S. Nat. Mus. 496335). $\times 2\frac{1}{2}$ .	
9. Exterior of left cotyle shown in Figure 7. $\times 2\frac{1}{2}$ .	
10. <i>Chione (Chamelea?) matutina</i> Gardner, n. sp.	125
Exterior of holotype, a right valve (U. S. Nat. Mus. 496457). $\times 2\frac{1}{2}$ .	
11. <i>Macrocallista (Chionella) cantui</i> Gardner, n. sp.	115
Interior of cotyle shown in Figure 8. $\times 2\frac{1}{2}$ .	
12. <i>Chione (Chamelea?) matutina</i> Gardner, n. sp.	125
Interior of holotype shown in Figure 10. $\times 2\frac{1}{2}$ .	
13-14. <i>Macrocallista (Chionella) cantui</i> Gardner, n. sp.?	115
13. Exterior of left valve (U. S. Nat. Mus. 496336). $\times 1\frac{1}{2}$ .	
14. Exterior of right valve (U. S. Nat. Mus. 496338). $\times 2$ .	
15. <i>Corbula (Erodona?) carlotae</i> Gardner, n. sp.	137
Exterior of right valve of holotype (U. S. Nat. Mus. 496262). $\times 2\frac{1}{2}$ .	
16. <i>Chione (Chamelea?) matutina</i> Gardner, n. sp.	125
Interior of paratype, a right valve (U. S. Nat. Mus. 496458). $\times 2$ .	
17. <i>Glycymeris</i> sp. cf. <i>G. mississippiensis</i> (Conrad)	51
Exterior of right valve (U. S. Nat. Mus. 495921). $\times 2$ .	
18. <i>Ampullina mississippiensis</i> (Conrad)	175
Apertural view of specimen (U. S. Nat. Mus. 496031). $\times 1$ .	
19-20. <i>Corbula (Erodona?) carlotae</i> Gardner, n. sp.	137
19. Exterior of left valve of holotype (U. S. Nat. Mus. 496262). $\times 2\frac{1}{2}$ .	
20. Dorsal view of double valves of holotype (U. S. Nat. Mus. 496262). $\times 2\frac{1}{2}$ .	
21. <i>Holospira eva</i> Gardner, n. sp.	266
Apertural view of holotype (U. S. Nat. Mus. 497095). $\times 2$ .	
22. <i>Conus (leptoconus?) protractus</i> Meyer?	254
Spire of incomplete specimen (U. S. Nat. Mus. 497096). $\times 3$ .	
23. <i>Ampullina mississippiensis</i> (Conrad)	175
Rear view of larger specimen (U. S. Nat. Mus. 496031). $\times 1$ .	
24. <i>Chlamys wahtubbeana</i> Dall	180
Exterior of left valve of holotype (U. S. Nat. Mus. 137612) from railroad cut near Indian Mound, $4\frac{1}{2}$ miles east of Newton, Newton County, Miss.; height, 17.0 millimeters; width, 16.9 millimeters. (After Dall).	



## PLATE 11.—TERTIARY MOLLUSCA

Figures	Page
1. <i>Pecten (Pecten)</i> sp. cf. <i>P. (P.) macdonaldi</i> Olsson.....	6
Interior of left valve (U. S. Nat. Mus. 495022). × 1.	
2. <i>Trachycardium</i> sp.....	103
Interior of right valve (U. S. Nat. Mus. 496456). × 2.	
3. <i>Pecten (Pecten)</i> sp. cf. <i>P. (P.) macdonaldi</i> Olsson.....	64
Exterior of left valve shown in Figure 1. × 1.	
4. <i>Chlamys (Nodipecten) dumblei</i> Gardner, n. sp.....	69
Exterior of paratype, a left valve (U. S. Nat. Mus. 494956). × 1.	
5. <i>Pitar (Hysteroconcha) mendezensis</i> Gardner, n. sp.....	123
Exterior of holotype, a right valve (U. S. Nat. Mus. 495051). × 2.	
6. <i>Chlamys (Nodipecten) dumblei</i> Gardner, n. sp.....	69
Exterior of paratype, a left valve (U. S. Nat. Mus. 494955). × 1.	
7. <i>Chlamys (Lyropecten?)</i> sp. cf. <i>C. (L?) nicholsi neotera</i> Gardner.....	68
Exterior of right valve (U. S. Nat. Mus. 495929). × 2.	
8. <i>Pitar (Hysteroconcha) mendezensis</i> Gardner, n. sp.....	123
Interior of holotype shown in Figure 5. × 2.	
9. <i>Chlamys (Lyropecten?)</i> sp. cf. <i>C. (L?) nicholsi neotera</i> Gardner.....	68
Exterior of left valve (U. S. Nat. Mus. 495929). × 2.	
10-11. <i>Callocardia (Agriopoma) calceola</i> Gardner.....	119
10. Interior of holotype, a left valve (U. S. Nat. Mus. 372888). × 1.	
11. Exterior of holotype shown in Figure 10. × 1.	





1



2



3



4



5



6



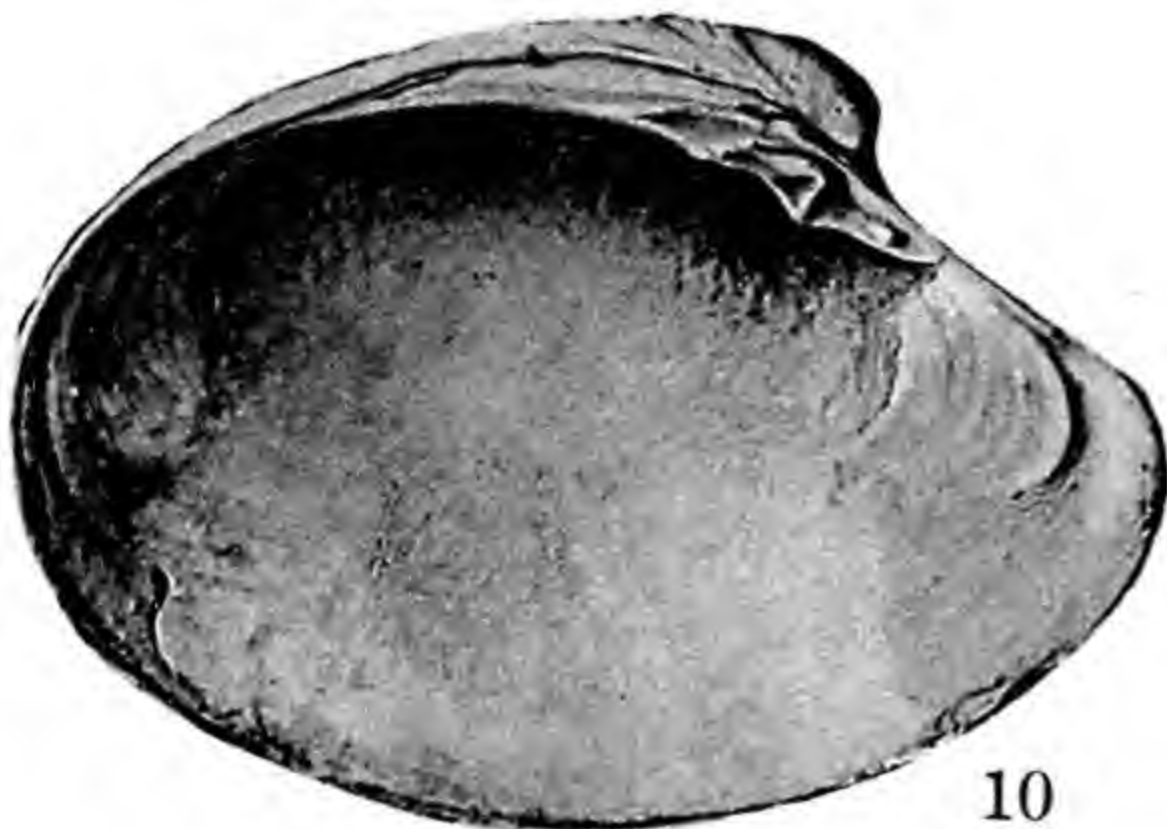
7



8



9

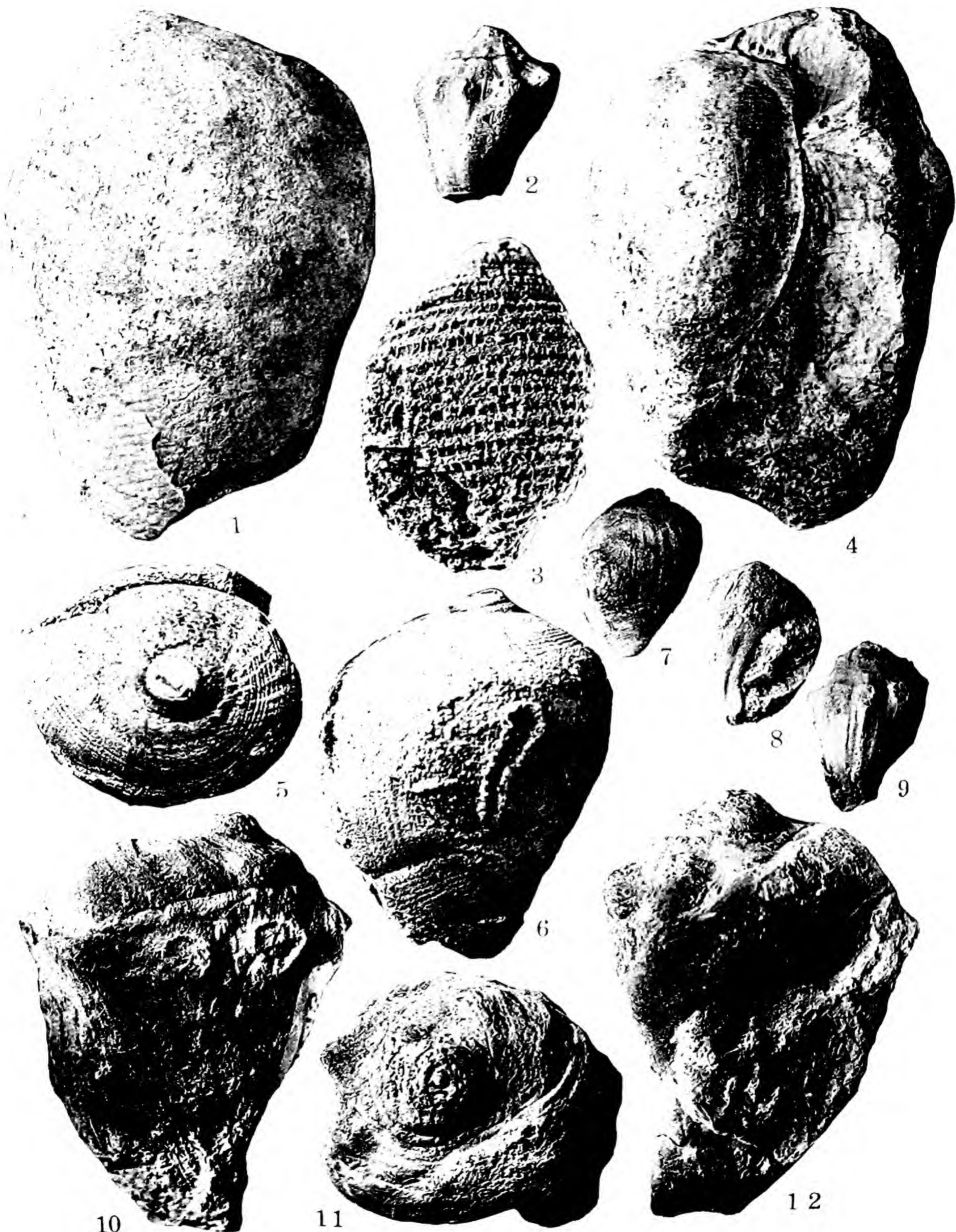


10



11





TERTIARY MOLLUSCA



## PLATE 12. TERTIARY MOLLUSCA

Figures	Page
1. <i>Lithophysema stewarti</i> Gardner, n. sp.....	263
Rear view of holotype (U. S. Nat. Mus. 494948). $\times 1$ .	
2. <i>Volutospina (Eoathleta) corvocada</i> Gardner, n. sp.....	227
Rear view of paratype (U. S. Nat. Mus. 494999). $\times 1\frac{1}{2}$ .	
3. <i>Tornatellaea cerralvensis</i> Gardner, n. sp.....	259
Rear view of holotype (U. S. Nat. Mus. 494969). $\times 10$ .	
4. <i>Lithophysema stewarti</i> Gardner, n. sp.....	263
Apertural view of holotype. $\times 1$ .	
5-8. <i>Pseudoliva nana</i> Gardner, n. sp.....	195
5. Apical view of paratype (U. S. Nat. Mus. 494008). $\times 4$ .	
6. Rear view of paratype shown in Figure 5. $\times 4$ .	
7. Rear view of holotype (U. S. Nat. Mus. 495007). $\times 2$ .	
8. Apertural view of holotype. $\times 2$ .	
9. <i>Volutospina (Eoathleta) corvocada</i> Gardner, n. sp.....	227
Rear view of holotype (U. S. Nat. Mus. 494997). $\times 1\frac{1}{2}$ .	
10-12. <i>Volutospina (Eoathleta) tuomeyi</i> (Conrad).....	228
10. Rear view of imperfect specimen (U. S. Nat. Mus. 495002). $\times 1\frac{1}{2}$ .	
11. Apical view of specimen shown in Figure 10. $\times 1\frac{1}{2}$ .	
12. Apertural view of specimen shown in Figure 10. $\times 1\frac{1}{2}$ .	



## PLATE 13.—TERTIARY MOLLUSCA

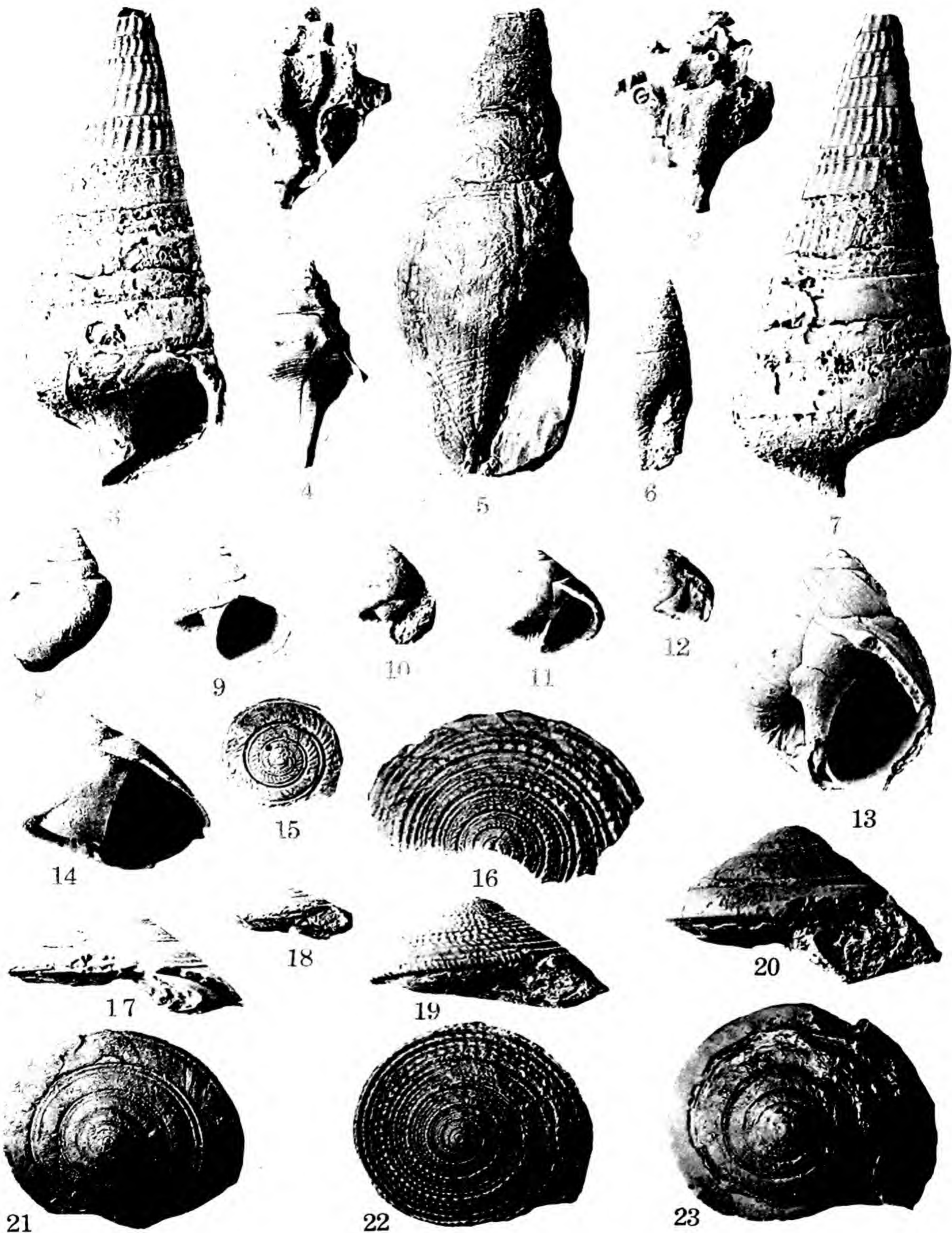
Figures	Page
1. <i>Amaurellina singleyi</i> (Harris).....	177
Apertural view of specimen (U. S. Nat. Mus. 496029). $\times 1\frac{1}{2}$ .	
2-3. <i>Ampullina quitrinensis</i> Gardner, n. sp.....	175
2. Apertural view of holotype (U. S. Nat. Mus. 497100). $\times 1$ .	
3. Apical view of holotype. $\times 1$ .	
4. <i>Amaurellina singleyi</i> (Harris).....	177
Rear view of specimen shown in Figure 1. $\times 1\frac{1}{2}$ .	
5. <i>Clavilithes penrosei</i> (Heilprin).....	209
Apertural view of imperfect specimen (U. S. Nat. Mus. 497103). $\times 1$ .	
6-8. <i>Ampullina quitrinensis</i> Gardner, n. sp.....	175
6. Rear view of paratype (U. S. Nat. Mus. 497102). $\times 2$ .	
7. Apical view of paratype shown in Figure 6. $\times 2$ .	
8. Apertural view of paratype shown in Figure 6. $\times 2$ .	





TERTIARY MOLLUSCA





TERTIARY MOLLUSCA



## PLATE 14.—TERTIARY MOLLUSCA

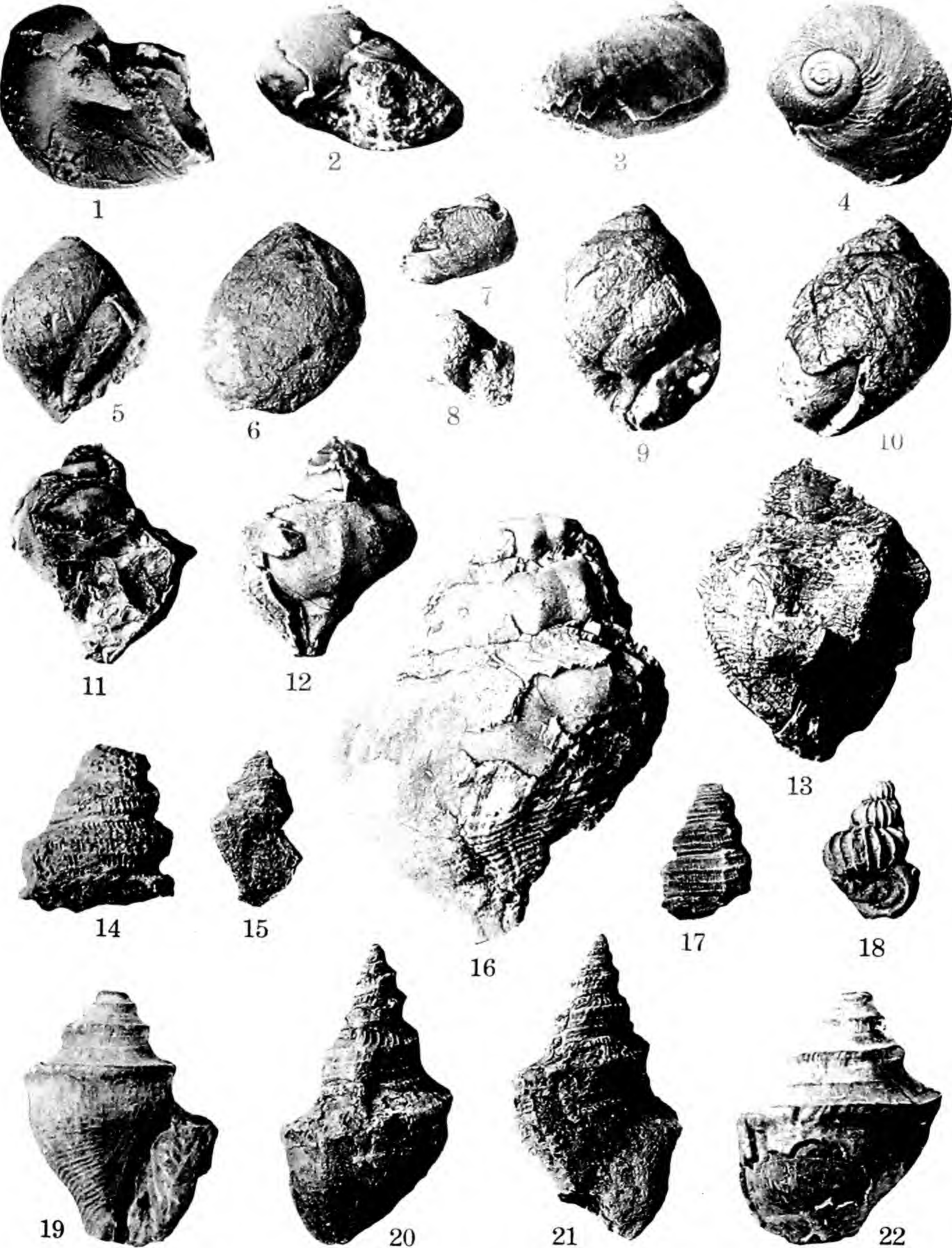
Figures	Page
1-2. <i>Typhis curvirostratus</i> Conrad.....	189
1. Apertural view of specimen (U. S. Nat. Mus. 497104). $\times 2\frac{1}{2}$ .	
2. Rear view of specimen shown in Figure 1. $\times 2\frac{1}{2}$ .	
3. <i>Cerithium vinctum</i> Whitfield.....	158
Apertural view of cotype (No. 24673, Hall Collection, Walker Museum, Univ. of Chicago). $\times 2$ .	
4. <i>Orthosurcula pagodiformis</i> (Heilprin).....	233
Apertural view of cotype (U. S. Nat. Mus. 1505). $\times 1$ .	
5. <i>Mitra (Fusimitra) millingtoni</i> Conrad.....	221
Apertural view of incomplete specimen (U. S. Nat. Mus. 497105). $\times 1$ .	
6. <i>Mitrella garzai</i> Gardner n. sp.....	189
Apertural view of holotype (U. S. Nat. Mus. 497106). $\times 5$ .	
7. <i>Cerithium vinctum</i> Whitfield.....	158
Rear view of cotype shown in Figure 3. $\times 2$ .	
8. <i>Amaurellina singleyi</i> (Harris).....	177
Rear view of specimen (U. S. Nat. Mus. 559285). $\times 2$ .	
9. <i>Gyrodes (Sigaretopsis) aperta</i> Whitfield.....	170
Apertural view of holotype (No. 24509, Hall Collection, Walker Museum, Univ. of Chicago). $\times 1\frac{1}{2}$ .	
10. <i>Neverita limula ceryx</i> Gardner, n. subsp.....	172
Apertural view of holotype (U. S. Nat. Mus. 497107). $\times 1$ .	
11. <i>Natica perspecta</i> Whitfield.....	171
Apertural view of holotype (No. 24517, Hall Collection, Walker Museum, Univ. of Chicago). $\times 1\frac{1}{2}$ .	
12. <i>Neverita limula ceryx</i> Gardner, n. subsp.....	172
Apertural view of paratype (U. S. Nat. Mus. 497108). $\times 1$ .	
13. <i>Polinices harrisii</i> Gardner.....	174
Apertural view of holotype (U. S. Nat. Mus. 373060). $\times 2$ . (After Gardner)	
14. <i>Neverita onusta</i> (Whitfield).....	173
Apertural view of holotype (No. 24518, Hall Collection, Walker Museum, University of Chicago). $\times 1\frac{1}{2}$ .	
15. <i>Architectonica</i> sp.....	151
Apical view of juvenile (U. S. Nat. Mus. 497112). $\times 2$ .	
16. <i>Architectonica</i> sp. cf. <i>A. josephi</i> Gardner, n. sp.....	153
Apical view of incomplete specimen (U. S. Nat. Mus. 497111). $\times 2$ .	
17. <i>Architectonica alveata</i> Conrad.....	151
Apertural view of specimen (U. S. Nat. Mus. No. 497109). $\times 2$ .	
18. <i>Architectonica</i> sp.....	151
Apertural view of juvenile shown in Figure 15. $\times 2$ .	
19. <i>Architectonica josephi</i> Gardner, n. sp.....	152
Apertural view of specimen (U. S. Nat. Mus. 497113). $\times 2$ .	
20-21. <i>Architectonica alveata</i> Conrad.....	151
20. Apertural view of specimen (U. S. Nat. Mus. 497110). $\times 2$ .	
21. Apical view of specimen shown in Figure 17.	
22. <i>Architectonica josephi</i> Gardner, n. sp.....	152
Apical view of specimen shown in Figure 19. $\times 2$ .	
23. <i>Architectonica alveata</i> Conrad.....	151
Apical view of specimen shown in Figure 20.	



## PLATE 15.—TERTIARY MOLLUSCA

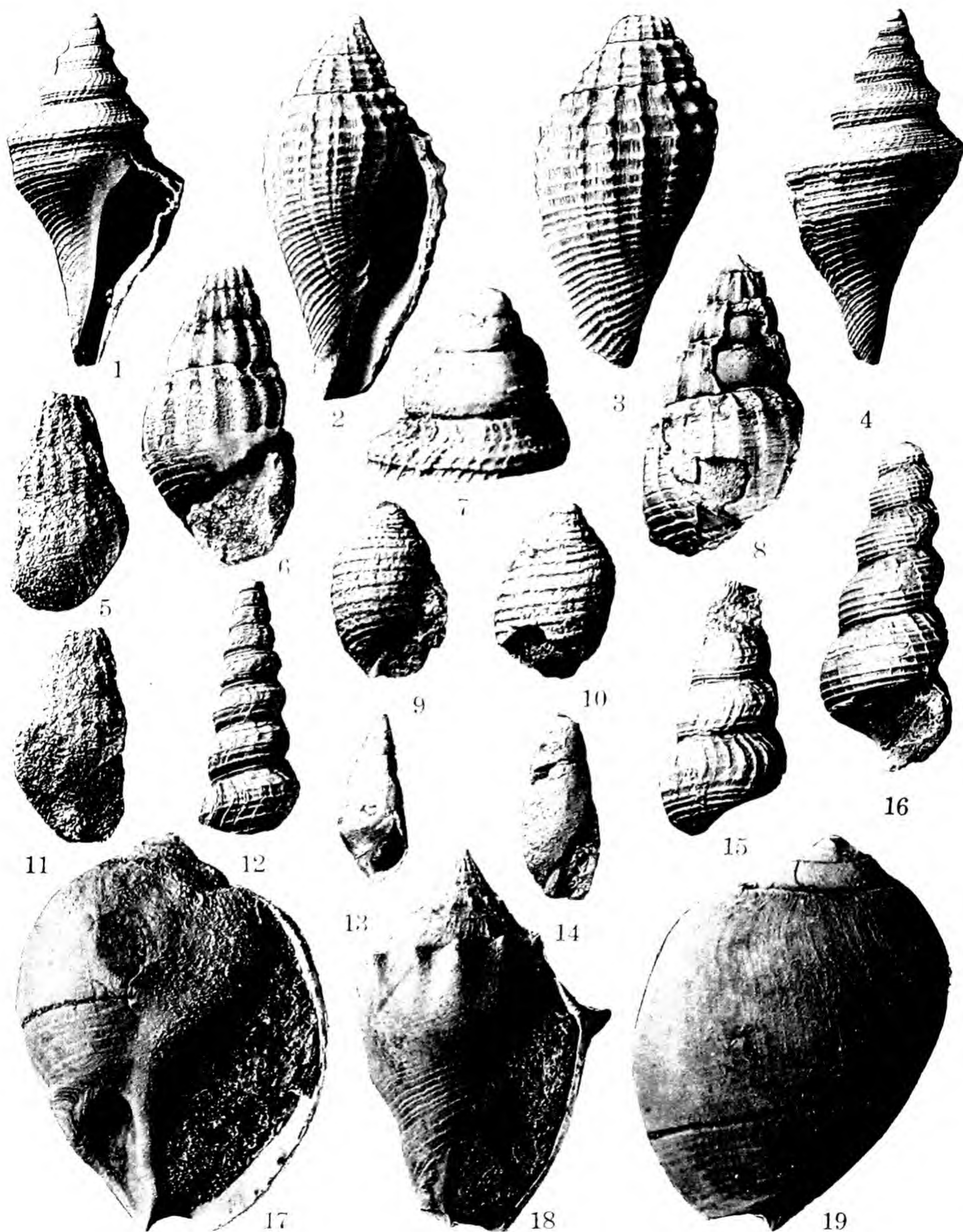
Figures		Page
1-4.	<i>Gyrodes (Sigaretopsis) canrenoides</i> Gardner n. sp.....	170
1.	Basal view of larger cotype (U. S. Nat. Mus. 495019). × 3.	
2.	Apertural view of smaller cotype (U. S. Nat. Mus. 495019). × 3.	
3.	Rear view of cotype shown in Figure 2. × 3.	
4.	Apical view of cotype shown in Figure 1. × 3.	
5-6.	<i>Polinices? alamedensis</i> Gardner, n. sp.....	173
5.	Apertural view of paratype (U. S. Nat. Mus. 495026). × 2.	
6.	Rear view of second paratype (U. S. Nat. Mus. 495026). × 2.	
7-8.	<i>Natica (Sigaretopsis) canrenoides</i> Gardner, n. sp.?.....	170
7.	Rear view of specimen (U. S. Nat. Mus. 495000). × 2.	
8.	Apertural view of specimen shown in Figure 7. × 2.	
9-10.	<i>Polinices? alamedensis</i> Gardner, n. sp.....	173
9.	Apertural view of holotype (U. S. Nat. Mus. 495009). × 2.	
10.	Rear view of holotype. × 2.	
11-12.	<i>Fasciolaria?</i> sp.....	215
11.	Apertural view of specimen (U. S. Nat. Mus. 495006). × 1.	
12.	Rear view of specimen shown in Figure 11.	
13.	<i>Incertae sedis</i> .....	215
	Rear view of specimen (U. S. Nat. Mus. 495016). × 2.	
14.	<i>Gegania texana</i> (Palmer)?.....	150
	Fragment of spire showing sculpture detail (U. S. Nat. Mus. 497115). × 3.	
15.	<i>Cochlespira bella</i> Conrad?.....	241
	Apertural view of specimen (U. S. Nat. Mus. 497116). × 3.	
16.	<i>Fasciolaria?</i> sp.....	215
	Rear view of imperfect specimen (U. S. Nat. Mus. 494972). × 1.	
17.	<i>Gegania texana</i> (Palmer)?.....	150
	Fragment of spire showing sculpture detail (U. S. Nat. Mus. 497117). × 2.	
18.	<i>Cirsotrema? cortezi</i> Gardner, n. sp.....	147
	Apertural view of specimen (U. S. Nat. Mus. 497118). × 2.	
19.	<i>Surculites cortezi</i> Gardner, n. sp.....	232
	Apertural view of holotype (U. S. Nat. Mus. 559287). × 1.	
20-21.	<i>Surculites cabezai</i> Gardner, n. sp.?.....	232
20.	Rear view of incomplete specimen (U. S. Nat. Mus. 559286). × 1½.	
21.	Apertural view of specimen shown in Figure 20.	
22.	<i>Surculites cortezi</i> Gardner, n. sp.....	232
	Rear view of holotype shown in Figure 19.	





TERTIARY MOLLUSCA





TERTIARY MOLLUSCA



## PLATE 16.—TERTIARY MOLLUSCA

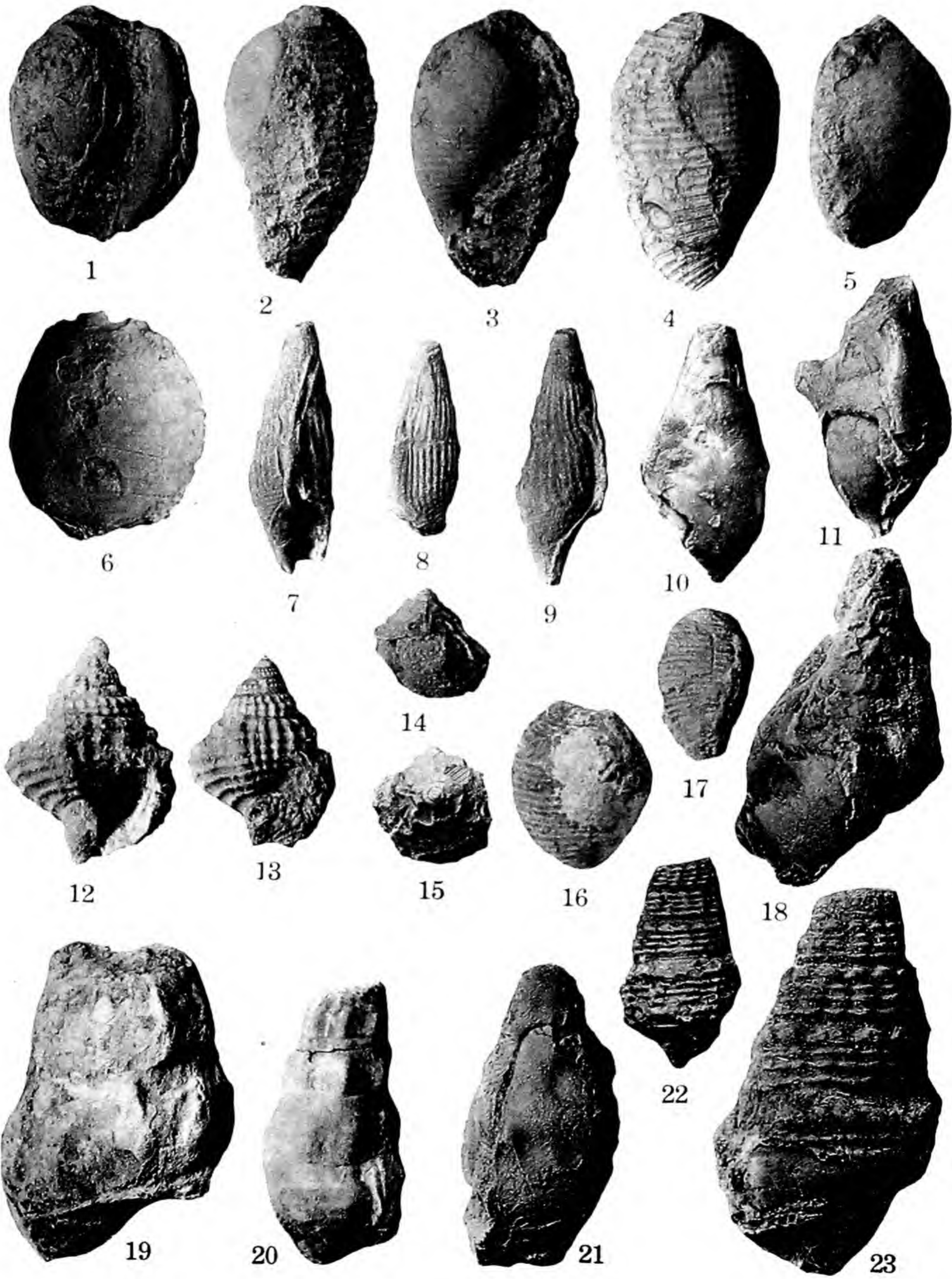
Figures	Page
1. <i>Surculites cabezai</i> Gardner, n. sp.....	232
Apertural view of holotype (U. S. Nat. Mus. 497417). $\times 2$ .	
2-3. <i>Volutocorbis texana</i> Gardner.....	223
2. Apertural view of holotype (U. S. Nat. Mus. 370998). $\times 2$ .	
3. Rear view of holotype. $\times 2$ .	
4. <i>Surculites cabezai</i> Gardner, n. sp.....	232
Rear view of holotype shown in Figure 1.	
5. <i>Tritiaria cerralvensis</i> Gardner, n. sp.....	190
Rear view of holotype (U. S. Nat. Mus. 495101). $\times 4$ .	
6. <i>Buccitriton chapai</i> Gardner, n. sp.....	192
Apertural view of holotype (U. S. Nat. Mus. 497851). $\times 4$ .	
7. <i>Surculites cabezai</i> Gardner, n. sp.....	232
Tip of holotype shown in Figure 1. $\times 10$ .	
8. <i>Buccitriton chapai</i> Gardner, n. sp.....	192
Rear view of holotype shown in Figure 6. $\times 4$ .	
9-10. <i>Nucleopsis</i> sp.....	260
9. Apertural view of specimen (U. S. Nat. Mus. 497440). $\times 10$ .	
10. Rear view of specimen shown in Figure 9. $\times 10$ .	
11. <i>Tritiaria cerralvensis</i> Gardner, n. sp.....	190
Apertural view of holotype shown in Figure 5. $\times 4$ .	
12. <i>Hemisinus miralejas</i> Gardner, n. sp.....	155
Apertural view of broken paratype (U. S. Nat. Mus. 495100). $\times 2\frac{1}{2}$ .	
13. <i>Hemisinus siliceus mexicanus</i> Gardner, n. subsp.....	155
Apertural view of holotype (U. S. Nat. Mus. 496014). $\times 1$ .	
14. <i>Olivella blastoides</i> Gardner, n. sp.....	218
Apertural view of holotype (U. S. Nat. Mus. 497668). $\times 4$ .	
15. <i>Hemisinus miralejas</i> Gardner, n. sp.....	155
Rear view of holotype (U. S. Nat. Mus. 495099). $\times 2\frac{1}{2}$ .	
16. <i>Scalina escandoni</i> Gardner, n. sp.....	148
Apertural view of holotype (U. S. Nat. Mus. 495098). $\times 2\frac{1}{2}$ .	
17. <i>Pseudoliva vetusta</i> (Conrad).....	196
Apertural view of specimen (U. S. Nat. Mus. 559291). $\times 2$ .	
18. <i>Volutospina petrosa</i> (Conrad).....	224
Apertural view of specimen (U. S. Nat. Mus. 559292). $\times 2$ .	
19. <i>Pseudoliva vetusta</i> (Conrad).....	196
Rear view of specimen shown in Figure 17. $\times 2$ .	



## PLATE 17.—TERTIARY MOLLUSCA

Figures		Page
1.	<i>Cypraedia</i> sp..... Apertural view of specimen (U. S. Nat. Mus. 497121). $\times 1\frac{1}{2}$ .	179
2-4.	<i>Cypraedia</i> sp..... 2. Lateral view of incomplete specimen (U. S. Nat. Mus. 497122). $\times 1\frac{1}{2}$ . 3. Apertural view of specimen shown in Figure 2. $\times 1\frac{1}{2}$ . 4. Rear view of specimen shown in Figure 2. $\times 1\frac{1}{2}$ .	179
5-6.	<i>Cypraedia</i> sp..... 5. Lateral view of specimen shown in Figure 1. $\times 1\frac{1}{2}$ . 6. Rear view of specimen shown in Figure 1. $\times 1\frac{1}{2}$ .	179
7.	<i>Rimella</i> sp..... Apertural view of specimen (U. S. Nat. Mus. 495014). $\times 1\frac{1}{2}$ .	165
8.	<i>Rimella</i> ( <i>Ectinochilus</i> ?) <i>carli</i> Gardner, n. sp..... Rear view of specimen (U. S. Nat. Mus. 497123). $\times 1\frac{1}{2}$ .	165
9.	<i>Rimella</i> sp..... Rear view of specimen shown in Figure 7. $\times 1\frac{1}{2}$ .	165
10.	<i>Calyptrophorus popenoe</i> Gardner..... Lateral view of incomplete specimen (U. S. Nat. Mus. 497124). $\times 1$ .	166
11.	<i>Calyptrophorus carrizensis</i> Gardner, n. sp..... Lateral view of holotype figured to show nodes (U. S. Nat. Mus. 495015). $\times 2\frac{1}{2}$ .	167
12-13.	<i>Personella septemdentata</i> (Gabb)..... 12. Apertural view of specimen (U. S. Nat. Mus. 497126). $\times 2$ . 13. Apertural view of specimen (U. S. Nat. Mus. 497127). $\times 2$ .	185
14-15.	<i>Xenophora</i> sp..... 14. Apertural view of specimen (U. S. Nat. Mus. 497125). $\times 2$ . 15. Apical view of specimen shown in Figure 14.	164
16.	<i>Cypraedia</i> sp..... Rear view of specimen (U. S. Nat. Mus. 497128). $\times 1$ .	179
17.	<i>Cypraedia</i> sp..... Rear view of specimen (U. S. Nat. Mus. 497129). $\times 1$ .	179
18.	<i>Calyptrophorus carrizensis</i> Gardner, n. sp..... Rear view of paratype (U. S. Nat. Mus. 495049). $\times 3$ .	167
19.	<i>Texmelanatria</i> sp. cf. <i>T. texana</i> (Heilprin)..... Later whorls of imperfect adult (U. S. Nat. Mus. 497131). $\times 1$ .	156
20.	<i>Texmelanatria angeloi</i> Gardner, n. sp..... Imperfect holotype (U. S. Nat. Mus. 497130). $\times 1$ .	157
21.	<i>Calyptrophorus carrizensis</i> Gardner, n. sp..... Rear view of second paratype (U. S. Nat. Mus. 495049). $\times 3$ .	167
22-23.	<i>Cerithium revillense</i> Gardner, n. sp..... 22. Rear view of holotype (U. S. Nat. Mus. 495012). $\times 1$ . 23. Rear view of paratype (U. S. Nat. Mus. 495013). $\times 2$ .	158





TERTIARY MOLLUSCA





1



2



3



4



5



6



7



8



9



10



11



12



13



## PLATE 18.—TERTIARY MOLLUSCA

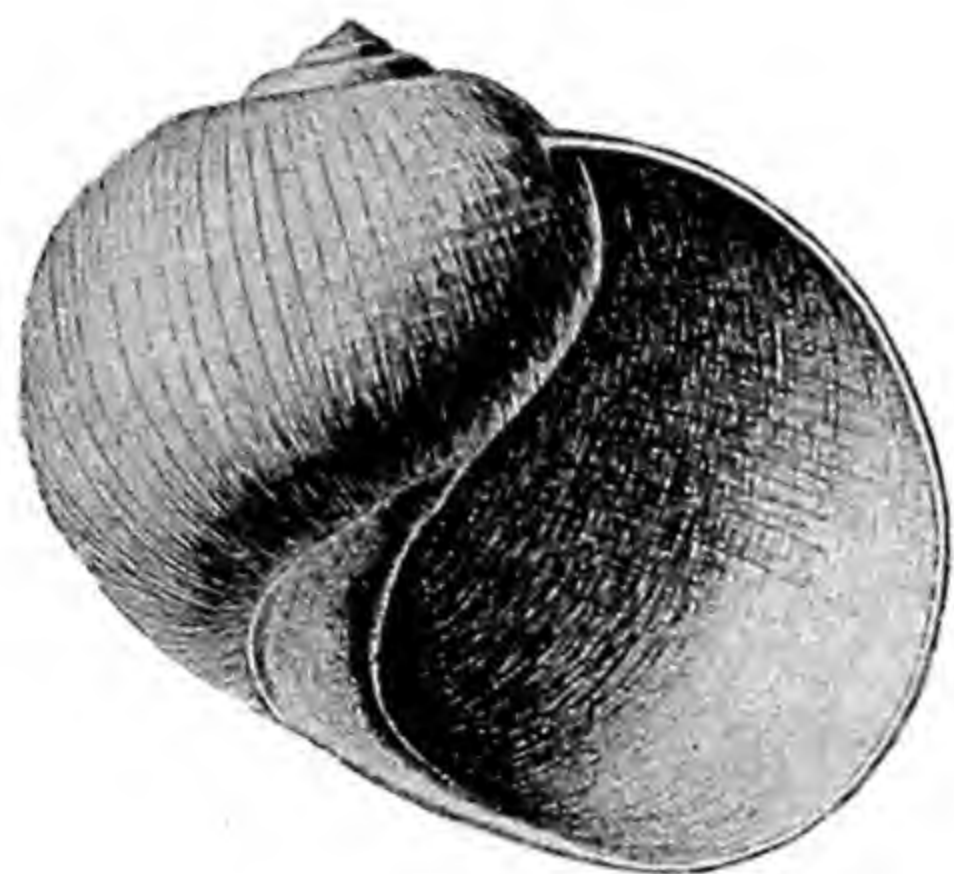
Figures		Page
1-3.	<i>"Helix"</i> sp.....	267
1.	Basal view of specimen (U. S. Nat. Mus. 497132). $\times 1$ .	
2.	Apertural view of specimen shown in Figure 1. $\times 1$ .	
3.	Apical view of specimen shown in Figure 1. $\times 1$ .	
4.	Platy sandstone packed with small gastropods, possibly cerithids (U. S. Nat. Mus. 495018).....	161
	View of weathered surface. $\times 2$ .	
5-6.	<i>Potamides? plicifera</i> (Heilprin).....	162
5.	Apertural view of specimen (U. S. Nat. Mus. 495011). $\times 1$ .	
6.	Apertural view of specimen (U. S. Nat. Mus. 495010). $\times 1$ .	
7-9.	<i>Cerithium? alejandroi</i> Gardner, n. sp.....	158
7.	Lateral view of paratype (U. S. Nat. Mus. 496443). $\times 2$ .	
8.	Detail of imperfectly preserved shell with adherent chara seeds (U. S. Nat. Mus. 497133). $\times 10$ .	
9.	Lateral view of incomplete paratype (U. S. Nat. Mus. 496443). $\times 2$ .	
10-11.	<i>Cerithium? sp. cf. C.? alejandroi</i> Gardner.....	159
10.	Lateral view of incomplete specimen (U. S. Nat. Mus. 496445). $\times 2$ .	
11.	Apertural view of specimen (U. S. Nat. Mus. 496444). $\times 2$ .	
12-13.	<i>Cerithium? alejandroi</i> Gardner, n. sp.....	158
12.	Rear view of incomplete paratype (U. S. Nat. Mus. 496443). $\times 2$ .	
13.	Rear view of holotype (U. S. Nat. Mus. 496442). $\times 1\frac{1}{2}$ .	



## PLATE 19.—TERTIARY MOLLUSCA

Figures	Page
1. <i>Ampullina fischeri</i> Dall.....	174
Apertural view of holotype slightly enlarged. (After Dall).	
2. <i>Ampullina amphora</i> (Heilprin).....	176
Apertural view of specimen (U. S. Nat. Mus. 494951). $\times 1$ .	
3-4. <i>Orthaulax pugnax</i> (Heilprin).....	169
3. Lateral view of specimen (U. S. Nat. Mus. 494947). $\times 1$ .	
4. Apical view of specimen shown in Figure 3. $\times 1$ .	
5. <i>Melongena</i> sp.....	201
Apical view of fragment of spire (U. S. Nat. Mus. 497257). $\times 1$ .	
6. <i>Murex (Murex) mississippiensis</i> Conrad.....	187
Apertural view of specimen (U. S. Nat. Mus. 497258). $\times 1\frac{1}{2}$ .	
7-9. <i>Cerithium mendezense</i> Gardner, n. sp.....	160
7. Apertural view of holotype (U. S. Nat. Mus. 494961). $\times 2$ .	
8. Apertural view of specimen (U. S. Nat. Mus. 497259). $\times 3$ .	
9. Basal view of holotype shown in Figure 7.	
10. <i>Cancellaria?</i> sp.....	229
Apertural view of incomplete specimen (U. S. Nat. Mus. 497260). $\times 4$ .	
11. <i>Cerithium hillsboroense</i> Heilprin.....	159
Rear view of specimen (U. S. Nat. Mus. 494965). $\times 2$ .	





1



2



3



4



5



6



7



8



9



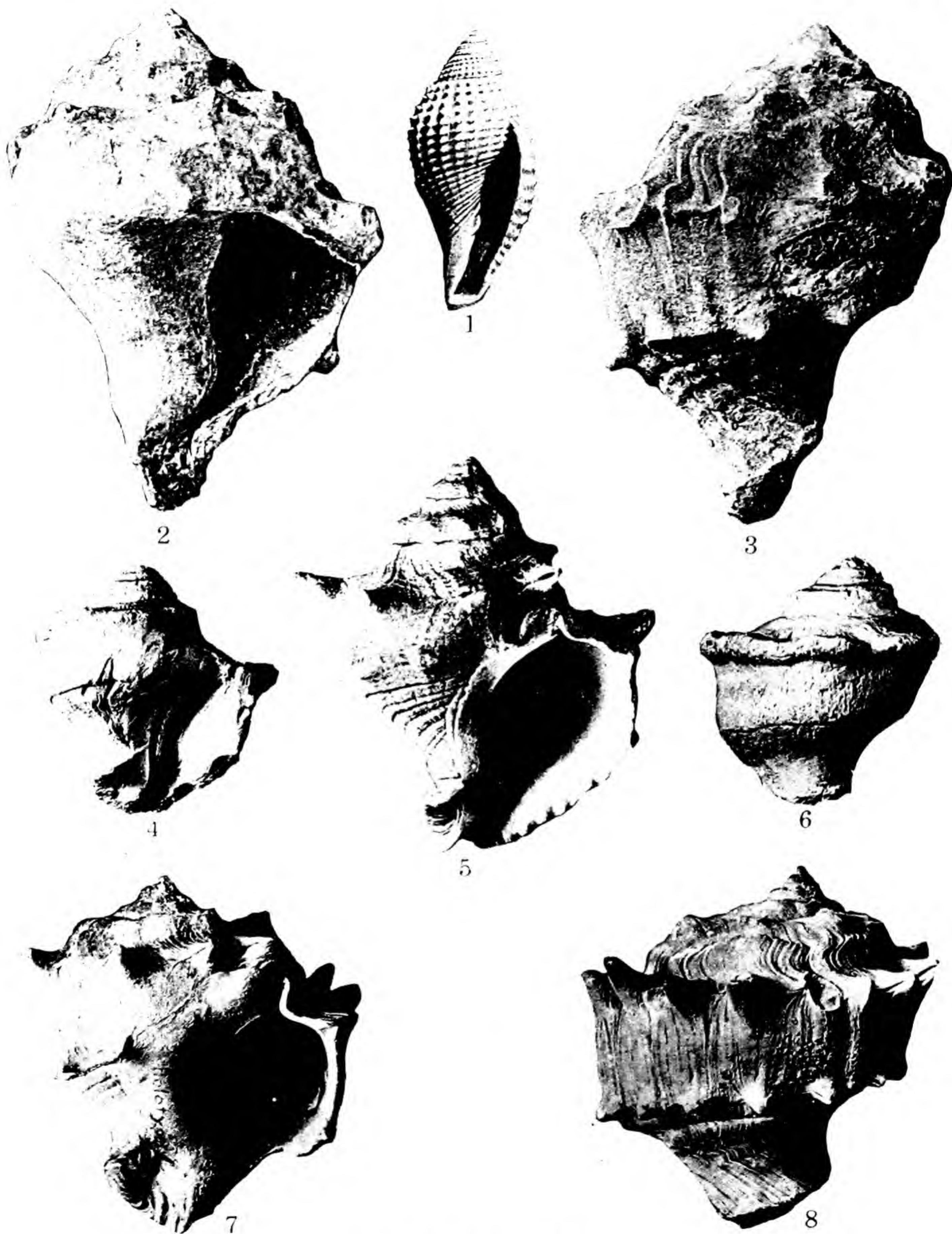
10



11

TERTIARY MOLLUSCA





TERTIARY MOLLUSCA



## PLATE 20.—TERTIARY MOLLUSCA

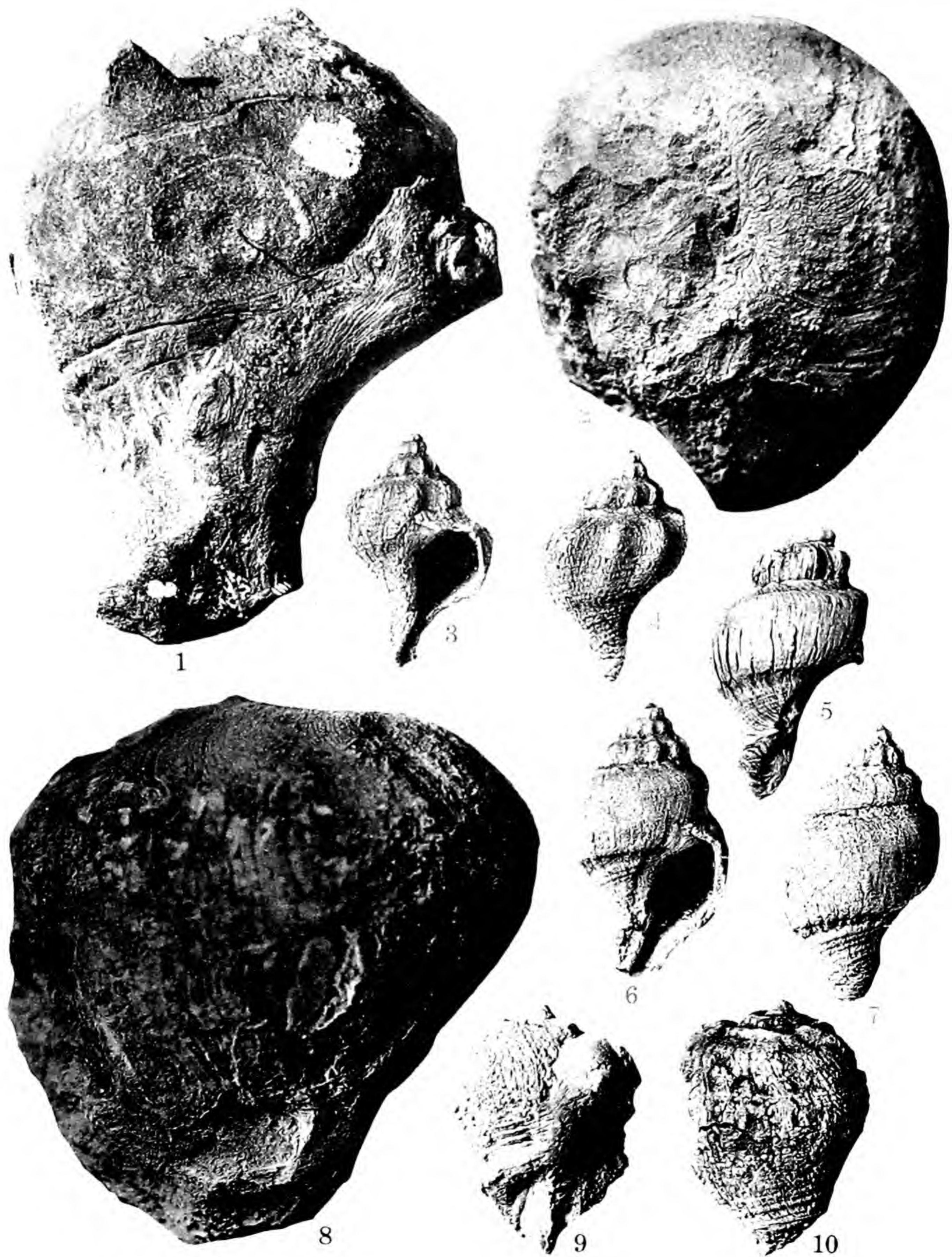
Figures	Page
1. <i>Volutocorbis limopsis</i> (Conrad).....	222
Apertural view of topotype?(U. S. Nat. Mus. 559305) from Mathews Landing, Alabama River, Wilcox County, Alabama. (After Cooke). $\times 1\frac{1}{2}$ .	
2-3. <i>Cornulina armigera</i> Conrad, s. l.....	202
2. Apertural view of specimen (U. S. Nat. Mus. 494971). $\times 1$ .	
3. Rear view of specimen shown in Figure 2. $\times 1$ .	
4. <i>Cornulina</i> ( <i>Revilla</i> ) <i>lita</i> Gardner, n. sp.....	203
Apertural view of holotype (U. S. Nat. Mus. 494954). $\times 1$ .	
5. <i>Cornulina minax</i> (Solander in Brander).....	201
Apertural view of genotype (U. S. Nat. Mus. 326445). $\times 1$ .	
6. <i>Cornulina</i> ( <i>Revilla</i> ) <i>lita</i> Gardner, n. sp.....	203
Rear view of holotype shown in Figure 4. $\times 1$ .	
7-8. <i>Cornulina armigera</i> Conrad, s. l.....	202
7. Apertural view of specimen (U. S. Nat. Mus. 494950). $\times 1$ .	
8. Rear view of specimen shown in Figure 7. $\times 1$ .	



## PLATE 21.—TERTIARY MOLLUSCA

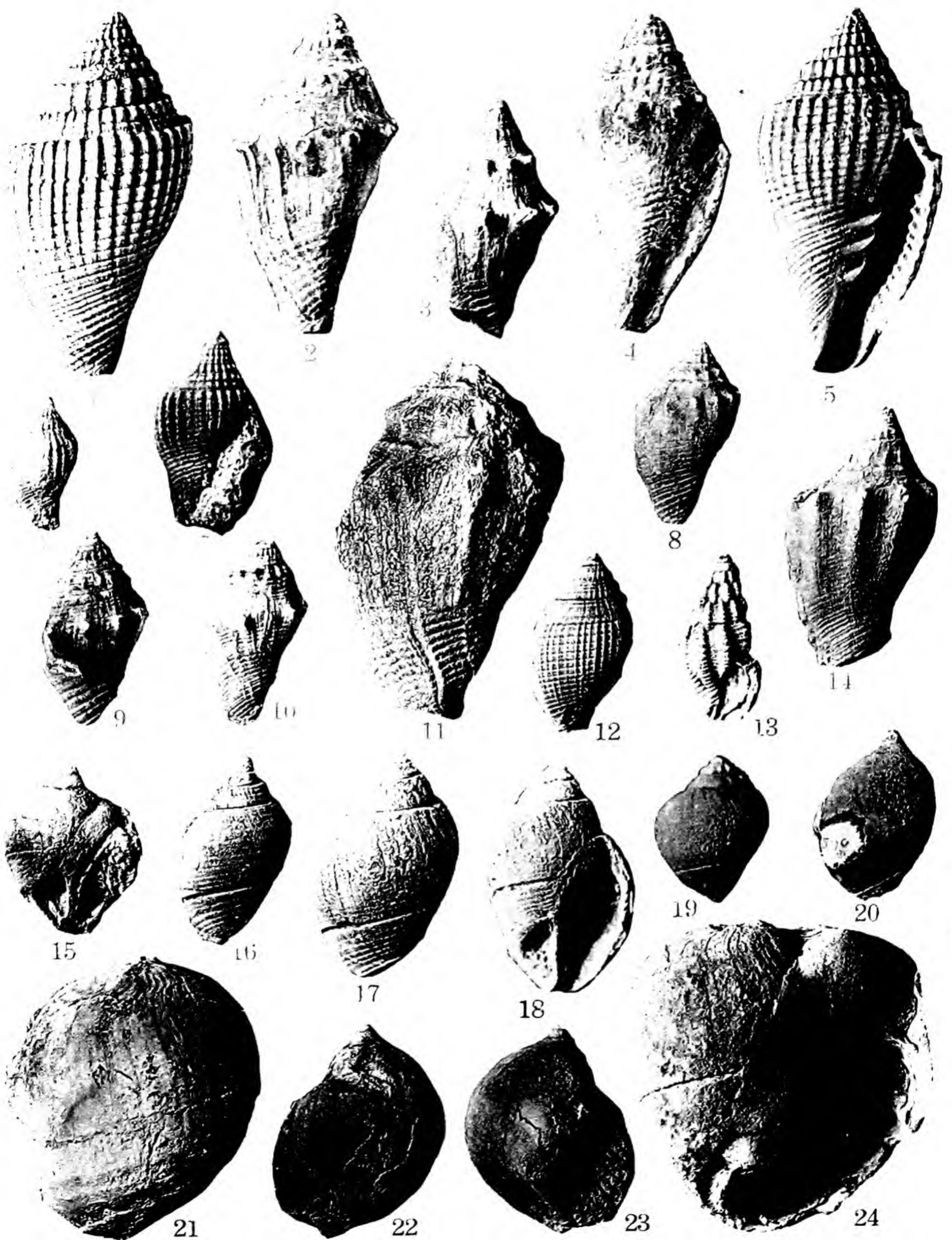
Figures	Page
1. <i>Cornulina armigera</i> Conrad.....	202
Lateral view of large but poorly preserved specimen (U. S. Nat. Mus. 497134). × 1.	
2. <i>Lacinia santander</i> Gardner, n. sp.....	204
Apical view of senile paratype (U. S. Nat. Mus. 497135). × 1.	
3-7. <i>Mazzalina? heilpriniana pyrobola</i> Gardner, n. subsp.....	214
3. Apertural view of adolescent topotype (U. S. Nat. Mus. 497136). × 2.	
4. Rear view of adolescent topotype shown in Figure 3. × 2.	
5. Rear view of imperfect topotype figured to show senile characters (U. S. Nat. Mus. 497138). × 1.	
6. Apertural view of holotype (U. S. Nat. Mus. 497137). × 2.	
7. Rear view of holotype. × 2.	
8-10. <i>Lacinia santander</i> Gardner, n. sp.....	204
8. Rear view of senile paratype shown in Figure 2. × 1.	
9. Apertural view of juvenile paratype (U. S. Nat. Mus. 497139). × 1.	
10. Rear view of juvenile paratype shown in Figure 9. × 1.	





TERTIARY MOLLUSCA







## PLATE 22.—TERTIARY MOLLUSCA

Figures	Page
1. <i>Volutocorbis? haealanus</i> (Whitfield).....	224
Rear view of holotype (No. 24672, Hall Collection, Walker Museum, Univ. of Chicago). × 2½.	
2-4. <i>Volutospina lapparoides</i> Gardner, n. sp.....	225
2. Rear view of holotype (U. S. Nat. Mus. 497140). × 1½.	
3. Rear view of incomplete paratype (U. S. Nat. Mus. 497141). × 1½.	
4. Apertural view of holotype shown in Figure 2. × 1½.	
5. <i>Volutocorbis? haealanus</i> (Whitfield).....	224
Apertural view of holotype shown in Figure 1.	
6. <i>Volutospina (Eoathleta) tuomeyi</i> (Conrad), juvenile.....	228
Rear view of juvenile specimen (U. S. Nat. Mus. 497142). × 1½.	
7. <i>Volutocorbis lapparoides</i> Gardner, n. sp.....	225
Apertural view of immature specimen (U. S. Nat. Mus. 497143). × 1½.	
8. <i>Volutospina symmetrica</i> (Conrad).....	226
Rear view of specimen (U. S. Nat. Mus. 497144). × 1.	
9-10. <i>Volutospina lapparoides</i> Gardner, n. sp., juvenile.....	225
9. Rear view of immature specimen (U. S. Nat. Mus. 497145). × 2.	
10. Rear view of incomplete specimen (U. S. Nat. Mus. 497146). × 2.	
11. <i>Volutocorbis? sp. cf. V.? wheelockensis</i> (Cossmann).....	223
Rear view of incomplete specimen (U. S. Nat. Mus. 497147). × 1½.	
12. <i>Volutocorbis sp. cf. V. olssoni</i> Plummer.....	223
Rear view of incomplete specimen (U. S. Nat. Mus. 497148). × 2.	
13. <i>Tritiaria? zacatensis</i> Gardner, n. sp.....	191
Apertural view of holotype (U. S. Nat. Mus. 497149). × 3.	
14. <i>Volutospina clayi</i> (Burnett Smith)?.....	224
Rear view of incomplete specimen (U. S. Nat. Mus. 497150). × 1½.	
15-18. <i>Pseudoliva carinata</i> Gabb?.....	197
15. Apertural view of imperfect specimen (U. S. Nat. Mus. 497252). × 1.	
16. Rear view of specimen (U. S. Nat. Mus. 497251). × 2.	
17. Rear view of specimen from the same locality (U. S. Nat. Mus. 497447). × 2.	
18. Apertural view of specimen shown in Figure 17. × 2.	
19. <i>Pseudoliva sp. cf. P. linosa</i> Gabb.....	198
Rear view of specimen (U. S. Nat. Mus. 497253). × 2.	
20-21. <i>Ancillopsis subglobosa</i> Conrad.....	199
20. Rear view of smaller specimen (U. S. Nat. Mus. 497254). × 1.	
21. Rear view of larger specimen (U. S. Nat. Mus. 497254). × 1.	
22-23. <i>Ancillopsis harrisi</i> (Palmer).....	200
22. Rear view of specimen (U. S. Nat. Mus. 497255). × 1½.	
23. Apertural view of specimen shown in Figure 22. × 1½.	
24. <i>Pseudoliva santander</i> Gardner, n. sp.....	195
Apertural view of holotype (U. S. Nat. Mus. 497256). × 1.	



## PLATE 23.—TERTIARY MOLLUSCA

Figures	Page
1. <i>Volutospina impressa</i> (Conrad).....	225
Apertural view of holotype (Acad. Nat. Sci. Philadelphia 13241). $\times 2$ .	
2. <i>Volutocorbis wheelockensis</i> (Cossmann).....	223
Apertural view of holotype (U. S. Nat. Mus. 111865) from $\frac{1}{2}$ mile east of Wheelock, Texas. $\times 2\frac{1}{2}$ . (After Dall).	
3. <i>Volutospina impressa</i> (Conrad).....	225
Rear view of holotype shown in Figure 1. $\times 2$ .	
4-6. <i>Architectonica acuta</i> subsp.? <i>meekana</i> Gabb.....	153
4. Apical view of holotype (Acad. Nat. Sci. Philadelphia 13291). $\times 4$ .	
5. Apertural view of holotype. $\times 5$ .	
6. Basal view of holotype. $\times 5$ .	
7. <i>Volutospina symmetrica</i> (Conrad).....	226
Apertural view of holotype (Acad. Nat. Sci. Philadelphia 13207). $\times 2$ .	
8-9. <i>Volutospina indenta</i> (Conrad).....	225
8. Apertural view of holotype (Acad. Nat. Sci. Philadelphia 13242). $\times 2$ .	
9. Rear view of holotype. $\times 2$ .	
10. <i>Volutospina symmetrica</i> (Conrad).....	226
Rear view of holotype shown in Figure 7. $\times 2$ .	





1



2



3



4



5



6



7



8



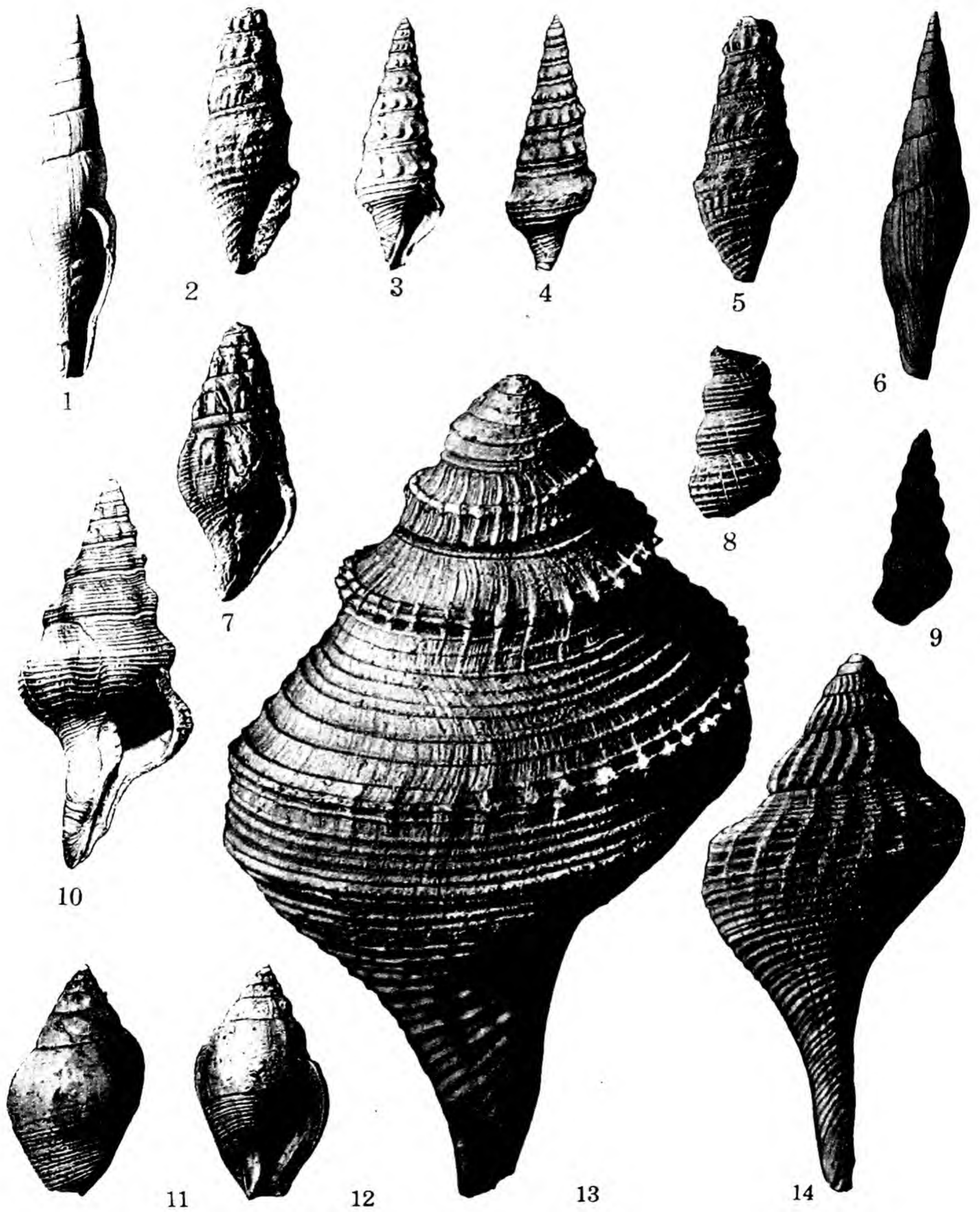
9



10

TERTIARY MOLLUSCA





TERTIARY MOLLUSCA



## PLATE 24.—TERTIARY MOLLUSCA

## Figures

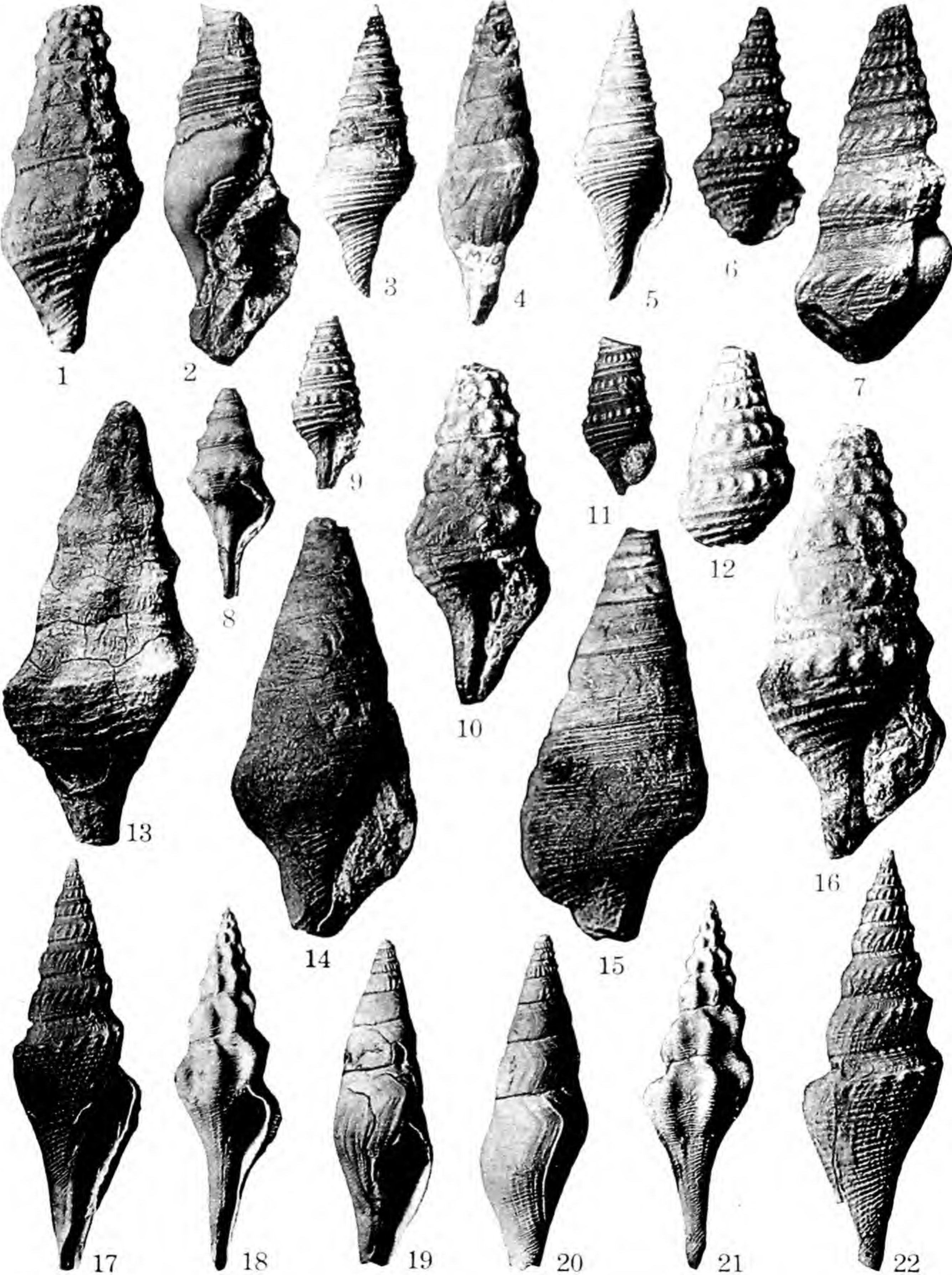
	Page
1. <i>Mitra (Fusimitra) polita neta</i> Gardner n. subsp.....	221
Apertural view of holotype (U. S. Nat. Mus. 497444) from Smithville, Texas. $\times 1\frac{1}{2}$ .	
2. <i>Hesperiturrus zacatensis</i> Gardner, n. sp.....	239
Apertural view of holotype (U. S. Nat. Mus. 497427). $\times 2\frac{1}{2}$ .	
3-4. <i>Hesperiturrus nodocarinata</i> (Gabb) s. l.....	237
3. Apertural view of lectotype (Acad. Nat. Sci. Philadelphia 13288). $\times 3$ .	
4. Rear view of lectotype. $\times 3$ .	
5. <i>Hesperiturrus zacatensis</i> Gardner, n. sp.....	239
Rear view of holotype shown in Figure 2.	
6. <i>Mitra (Fusimitra) polita neta</i> Gardner, n. subsp.....	221
Rear view of holotype shown in Figure 1. $\times 1\frac{1}{2}$ .	
7. <i>Latirus? (Polygona) neoulios</i> Gardner, n. sp.....	212
Apertural view of holotype (U. S. Nat. Mus. 497270). $\times 3$ .	
8. <i>Scalina</i> sp. cf. <i>S. trigintanaria</i> (Conrad).....	148
Rear view of specimen (U. S. Nat. Mus. 497266). $\times 2$ .	
9. <i>Scalina trigintanaria</i> (Conrad)?.....	148
Rear view of specimen (U. S. Nat. Mus. 497446). $\times 2$ .	
10. <i>Latirus (Polygona) moorei</i> (Gabb).....	211
Apertural view of holotype (Acad. Nat. Sci. Philadelphia 13279). $\times 1\frac{1}{2}$ .	
11-12. <i>Pseudoliva fusiformis</i> Gabb.....	197
11. Rear view of holotype (Acad. Nat. Sci. Philadelphia 13269). $\times 3$ .	
12. Apertural view of holotype. $\times 3$ .	
13. <i>Michela trabeatoides</i> (Harris).....	231
Tip of specimen (U. S. Nat. Mus. 497445). $\times 10$ .	
14. <i>Levifusus trabeatus</i> Conrad.....	231
Tip of topotype (U. S. Nat. Mus. 129444) from Claiborne, Ala. $\times 10$ .	



## PLATE 25.—TERTIARY MOLLUSCA

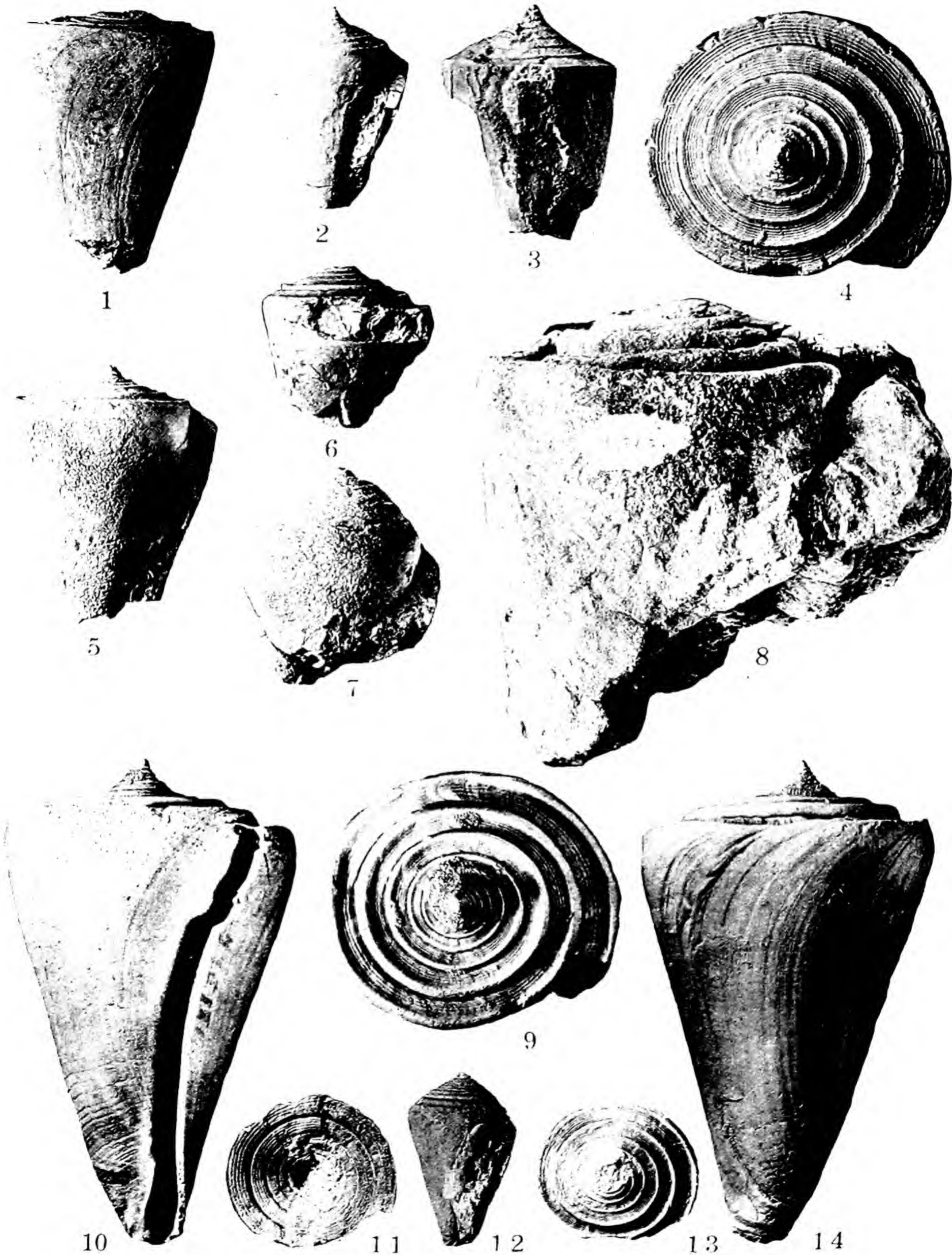
Figures	Page
1. <i>Hesperiturris amichel</i> Gardner, n. sp.....	238
Rear view of paratype (U. S. Nat. Mus. 497422). × 3.	
2. <i>Eosurcula moorei</i> (Gabb) s. l.....	235
Apertural view of specimen (U. S. Nat. Mus. 497419). × 2.	
3. <i>Plentaria plenta</i> (Aldrich and Harris).....	234
Rear view of paratype (Aldrich Collection, Johns Hopkins University). × 2.	
4. <i>Hemisurcula eosilicata</i> Gardner, n. sp.....	247
Rear view of holotype (U. S. Nat. Mus. 494963). × 1.	
5. <i>Plentaria plenta</i> (Aldrich and Harris).....	234
Apertural view of paratype shown in Figure 3.	
6. <i>Cochlespira</i> sp.....	242
Apertural view of specimen (U. S. Nat. Mus. 497423). × 3.	
7. <i>Hesperiturris nodocarinata</i> (Gabb) s. l.....	237
Rear view of specimen (U. S. Nat. Mus. 497424). × 3.	
8. <i>Orthosurcula? adeona</i> (Whitfield).....	233
Apertural view of holotype (No. 24523, Hall Collection, Walker Museum, Univ. of Chicago). × 1½.	
9. <i>Coronia genetiva</i> (Casey)?.....	241
Apertural view of specimen (U. S. Nat. Mus. 497430). × 3.	
10. <i>Hesperiturris amichel</i> Gardner, n. sp.....	238
Apertural view of paratype shown in Figure 1. × 3.	
11. <i>Coronia genetiva</i> (Casey)?.....	241
Apertural view of specimen (U. S. Nat. Mus. 497431). × 3.	
12. <i>Coronia?</i> sp.....	240
Rear view of specimen (U. S. Nat. Mus. 559394). × 3.	
13. <i>Surculoma</i> sp.....	243
Rear view of specimen (U. S. Nat. Mus. 497428). × 3.	
14-15. <i>Protosurcula gabbii</i> (Conrad) s. l.....	234
14. Apertural view of specimen (U. S. Nat. Mus. 497418). × 2.	
15. Rear view of specimen shown in Figure 14. × 2.	
16. <i>Hesperiturris amichel</i> Gardner, n. sp.....	238
Apertural view of holotype (U. S. Nat. Mus. 497421). × 3.	
17. <i>Orthosurcula? langdoni</i> (Aldrich).....	233
Apertural view of holotype (Aldrich Collection, Johns Hopkins University). × 2.	
18. " <i>Pleurotoma</i> " <i>servatoidea</i> Aldrich.....	243
Apertural view of holotype (Aldrich Collection, Johns Hopkins University). × 2.	
19-20. <i>Hemisurcula silicata</i> (Aldrich).....	247
19. Apertural view of holotype (Aldrich Collection, Johns Hopkins University). × 2.	
20. Rear view of holotype. × 2.	
21. " <i>Pleurotoma</i> " <i>servatoidea</i> Aldrich.....	243
Rear view of holotype shown in Figure 18. × 2.	
22. <i>Orthosurcula? langdoni</i> (Aldrich).....	233
Rear view of holotype shown in Figure 17. × 2.	





TERTIARY MOLLUSCA





TERTIARY MOLLUSCA



## PLATE 26.—TERTIARY MOLLUSCA

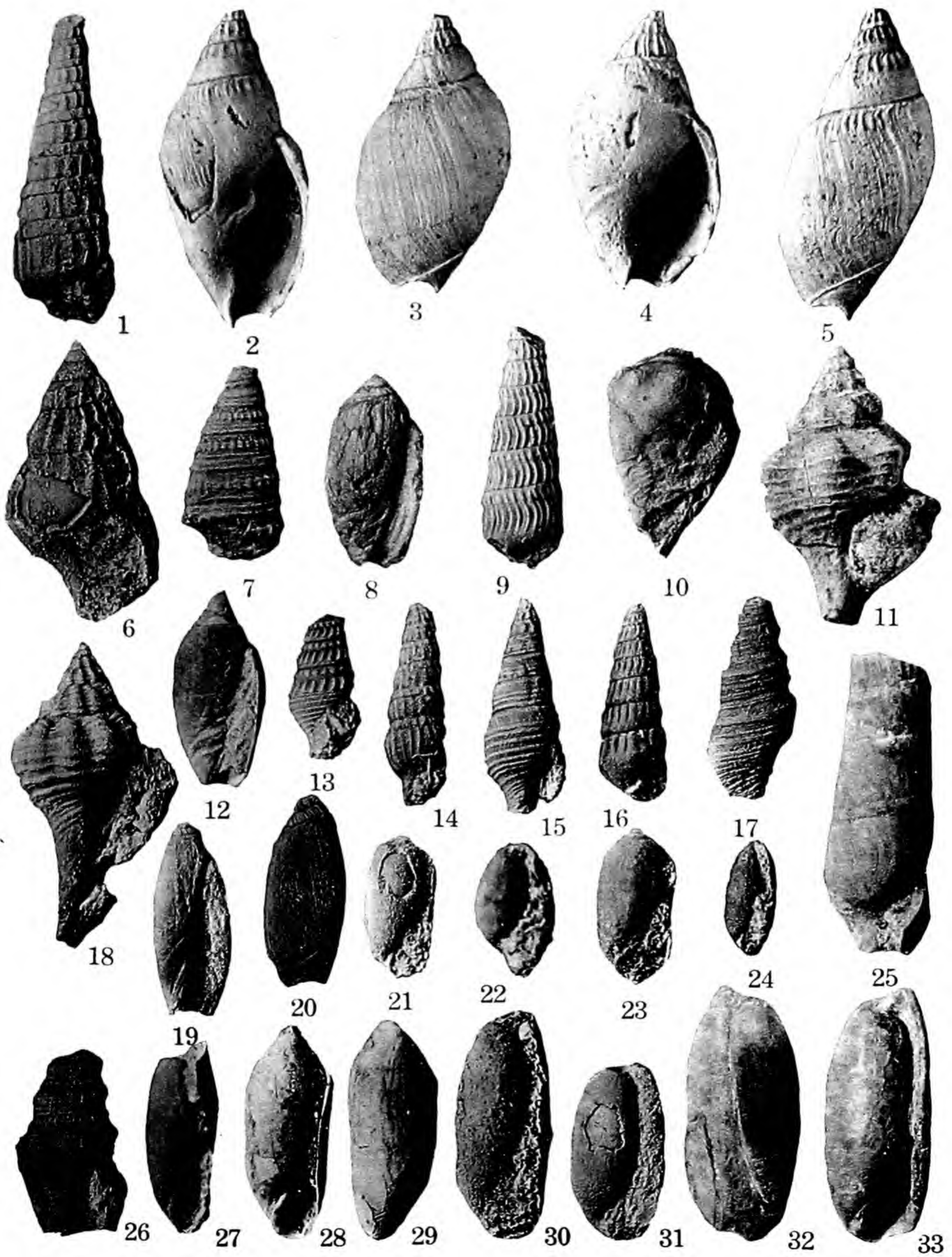
Figures	Page
1. <i>Conus (Leptoconus) tortilus</i> Conrad.....	253
Rear view of incomplete specimen (U. S. Nat. Mus. 497098). $\times 1$ .	
2. <i>Conus (Leptoconus) haighti</i> Gardner, n. sp.....	252
Apertural view of incomplete specimen (U. S. Nat. Mus. 496037). $\times 1$ .	
3. <i>Conus (Leptoconus) alveatus</i> Conrad.....	254
Incomplete specimen figured to show regularity of spire (U. S. Nat. Mus. 496036). $\times 1\frac{1}{2}$ .	
4. <i>Conus (Leptoconus) tortilus</i> Conrad.....	253
Apical view of incomplete specimen (U. S. Nat. Mus. 497097). $\times 1\frac{1}{2}$ .	
5. <i>Conus (Leptoconus) santander</i> Gardner, n. sp.....	251
Apertural view of incomplete specimen (U. S. Nat. Mus. 496034). $\times 1$ .	
6. <i>Conus (Leptoconus) tortilus</i> Conrad.....	253
Incomplete specimen figured to show profile of spire (U. S. Nat. Mus. 497099). $\times 1$ .	
7. <i>Conus (Leptoconus) haighti</i> Gardner, n. sp.....	252
Paratype figured to show profile of spire (U. S. Nat. Mus. 495183). $\times 1$ .	
8. <i>Conus (Leptoconus) tortilus</i> Conrad.....	253
Poorly preserved adult (U. S. Nat. Mus. 494949). $\times 1$ .	
9-10. <i>Conus (Leptoconus) santander</i> Gardner, n. sp.....	251
9. Apical view of holotype (U. S. Nat. Mus. 495181). $\times 1\frac{1}{2}$ .	
10. Apertural view of holotype. $\times 1\frac{1}{2}$ .	
11. <i>Conus (Leptoconus) alveatus</i> Conrad.....	254
Apical view of specimen shown in Figure 3. $\times 1\frac{1}{2}$ .	
12. <i>Conus (Leptoconus)</i> sp.....	253
Apertural view of an immature individual (U. S. Nat. Mus. 496035). $\times 1$ .	
13. <i>Conus (Leptoconus) tortilus</i> Conrad.....	253
Apical view of specimen shown in Figure 6. $\times 1$ .	
14. <i>Conus (Leptoconus) santander</i> Gardner, n. sp.....	251
Rear view of holotype shown in Figure 10. $\times 1\frac{1}{2}$ .	



## PLATE 27.—TERTIARY MOLLUSCA

Figures	Page
1. <i>Terebra (Strioterebrum) tantula</i> Conrad?.....	255
Apertural view of specimen (U. S. Nat. Mus. 497261). × 3.	
2. <i>Monoptygma leai</i> Whitfield.....	195
Apertural view of cotype (No. 24671, Hall Collection, Walker Museum, Univ. of Chicago). × 2½.	
3-4. <i>Pseudoliva elliptica</i> Whitfield.....	195
3. Rear view of holotype (No. 24670, Hall Collection, Walker Museum, Univ. of Chicago). × 2½.	
4. Apertural view of holotype. × 2½.	
5. <i>Monoptygma leai</i> Whitfield.....	195
Rear view of specimen shown in Figure 2.	
6. <i>Calyptrophorus carrizensis</i> Gardner, n. sp.?, juvenile.....	167
Apertural view of specimen (U. S. Nat. Mus. 497262). × 6.	
7. <i>Coronia margaritosa</i> (Casey)?.....	240
Fragmentary spire (U. S. Nat. Mus. 497263). × 3.	
8. <i>Oliva mendezensis</i> Gardner, n. sp.....	217
Apertural view of holotype (U. S. Nat. Mus. 497264). × 1½.	
9. <i>Terebra (Strioterebrum)</i> sp. cf. <i>T. (S.) texagyra</i> Harris.....	256
Lateral view of specimen (U. S. Nat. Mus. 497442). × 3.	
10. <i>Volutospina (Eoathleta) corvocada</i> Gardner, n. sp.....	227
Apertural view of paratype (U. S. Nat. Mus. 494998). × 1½.	
11. <i>Falsifusus carexus</i> (Harris).....	208
Apertural view of incomplete specimen (U. S. Nat. Mus. 497269). × 2.	
12. <i>Oliva mississippiensis santander</i> Gardner, n. subsp.....	217
Apertural view of holotype (U. S. Nat. Mus. 497268). × 2.	
13. <i>Hesperiturris nodocarinata</i> (Gabb) s. l.....	237
Apertural view of specimen (U. S. Nat. Mus. 559393). × 3.	
14. <i>Terebra (Strioterebrum) tantula</i> Conrad?.....	255
Apertural view of specimen (U. S. Nat. Mus. 497261). × 3.	
15. <i>Trypanotopsis texana</i> (Gabb).....	244
Apertural view of specimen (U. S. Nat. Mus. 497265). × 3.	
16. <i>Turbonilla bidentata</i> (Meyer)?.....	146
Apertural view of specimen (U. S. Nat. Mus. 497443). × 6.	
17. <i>Eosurcula moorei</i> (Gabb)?.....	235
Rear view of specimen (U. S. Nat. Mus. 497420). × 1½.	
18. <i>Falsifusus mortoniopsis</i> (Gabb).....	208
Apertural view of specimen (U. S. Nat. Mus. 497267). × 2.	
19-20. <i>Olivula punctulifera</i> (Gabb).....	219
19. Apertural view of specimen (U. S. Nat. Mus. 497669). × 2.	
20. Rear view of specimen shown in Figure 19. × 2.	
21. <i>Acteocina melinoides</i> Gardner, n. sp.....	261
Apertural view of paratype (U. S. Nat. Mus. 497433). × 6.	
22. <i>Atys? (Aliculastrum?)</i> sp.....	262
Apertural view of specimen (U. S. Nat. Mus. 497439). × 6.	
23. <i>Acteocina melinoides</i> Gardner, n. sp.....	261
Apertural view of holotype (U. S. Nat. Mus. 497434). × 6.	
24. <i>Volvulella garzai</i> Gardner, n. sp.....	261
Apertural view of holotype (U. S. Nat. Mus. 497435). × 6.	
25. <i>Terebra (Strioterebrum)</i> sp. cf. <i>T. (S.) texagyra</i> Harris.....	256
Apertural view of specimen (U. S. Nat. Mus. 497441). × 3.	
26. <i>Euchelodon</i> sp. cf. <i>E. creno-carinata</i> Heilprin.....	250
Apertural view of specimen (U. S. Nat. Mus. 497425). × 3.	
27. <i>Cylichna (Acrotrema) kellogii</i> (Gabb).....	264
Apertural view of specimen (U. S. Nat. Mus. 497436). × 6.	
28-29. <i>Volvulella volutata</i> (Meyer and Aldrich).....	262
28. Apertural view of holotype from Newton, Newton County, Miss. (Coll. Johns Hopkins University, Baltimore). × 6.	
29. Rear view of holotype. × 6.	
30. <i>Cylichna (Acrotrema)</i> sp. cf. <i>C. (A.) kellogii</i> (Gabb).....	264
Apertural view of specimen (U. S. Nat. Mus. 497437). × 6.	
31. <i>Cylichna (Acrotrema)</i> sp. cf. <i>C. (A.) jacksonensis</i> Meyer.....	265
Apertural view of specimen (U. S. Nat. Mus. 497448). × 3.	
32-33. <i>Cylichna (Acrotrema) agatha</i> Gardner, n. sp.....	264
32. Rear view of holotype (U. S. Nat. Mus. 497438). × 3.	
33. Apertural view of holotype. × 3.	





TERTIARY MOLLUSCA







## INDEX\*

- Abderospira cranchii*, 263  
*abruptus*, *Cadulus*, 143  
*abruptus*, *Solen* (*Plectosolen*) *lisbonensis*, 111  
*abruptus*, *Solena lisbonensis*, 111  
*abruptus*, *Solena* (*Eosolen*) *lisbonensis*, **111**  
 Abstract, 1  
*abyssicola*, *Volutilithes*, 222  
*acala*, *Leda*, 44, 45  
*Acanthina* (*Gastridium*) *vetusta*, 196  
*Acar*, **53**  
 Ackerman formation, 5  
 Acknowledgements, v  
*Acrilla*, 147  
*Acrotrema*, **263**, 264  
*Actaeon costellatus*, 259  
     *latus*, 259  
     *subvaricatus*, 259  
*Actaeonina*, 259  
*Actaeonina subvaricata*, 259  
*Acteocina*, **260**, 261  
*Acteocina melinoides*, 37, **261**, Pl. 27, figs. 21, 23  
*Acteocinidae*, 260  
*Acteon*, 259, 260, 261  
*Acteon annectens*, 259  
     *Wetherellii*, 260, 261  
     *Wetherilli*, 260  
*Acteonidae*, 258  
*acula*, *Architectonica* (*Granosolarium*), 153  
*acutirostra*, *Pleurotoma*, 240  
*acutum*, *Solarium*, 153  
*adansonii*, *Cerithium*, 158  
*adeona*, *Orthosurcula*?, 233, 234  
*Adesmacea*, 138  
*Adrana*, **49**  
*Adrana aldrichiana*, **49**, 50  
*aepynotus*, *Sycotypus*, 206  
*Aequipecten*, **67**  
*affinis*, *Voluta*, 227  
*Agaronia punctulifera*, 219  
*agatha*, *Cylichna*, 265  
*agatha*, *Cylichna* (*Acrotrema*), 36, **264**  
*Agina*, 127  
*Agriopoma*, **116**  
*Agualeguas*, 4, 6, 8  
*Aguilera*, Jose G., 270  
*Alaba*, **162**  
*Alaba melanura*, 162  
 Alabama, 5, 7, 8, 9  
     *alabamense*, *Pseudamussium*, 70  
     *alabamensis*, *Aturia*, 268  
     *alabamensis*, *Modiola*, 57  
     *alabamensis*, *Musculus*, 57  
     *alabamiensis*, *Corbula*, 129, 132, 133, 134  
     *alabamiensis*, *Corbula* (*Cuneocorbula*), 133  
     *alabamiensis*, *Modiolaria*, 57  
     *alabamiensis*, *Natica* (*Girodes*), 170  
     *alabamiensis*, *Ostrea*, 81, 82  
         *contracta*, *Ostrea*, 81  
         *georgiana*, *Ostrea*, 81  
     *alamedensis*, *Polinices*?, **173**, 174  
     *alba*, *Anodontia*, 94  
     *albicarinata*, *Pleurotoma*, 246  
     *albida tellea*, *Pleurotoma*, 246  
     *albirupina*, *Leda*, 46  
     *albus*, *Polinices*, 173  
     *aldrichi*, *Cadulus*, 143, 144  
     *aldrichi*, *Cadulus* (*Gadila*?), 143  
     *aldrichi*, *Corbula*, 132  
         *smithvillensis*, *Corbula*, 128  
     *aldrichi*, *Corbula* (*Caryocorbula*), **132**  
     *aldrichiana*, *Adrana*, **49**, 50  
     *aldrichiana*, *Leda* (*Adrana*), 49  
     *aldrichiella*, *Microdrillia*, 247, 248  
     *aldrovandi*, *Panope*, 138  
     *Alectrion waltonensis*, 194  
     *alejandroi*, *Cerithium*?, **158**, 159  
     *Alicula*, 262  
     *alicula*, *Trigoniocardia*, 104  
     *Aliculastrum*, **262**  
     *Aloidis*, 127  
     *Aloidis guineensis*, 127  
     *alta*, *Crassatella*, 113  
     *alternata*, *Tuba*, 149  
     *altile*, *Bullia*, 200  
         *harrisi*, *Bullia*, 200  
     *altilis*, *Ancillopsis*, 195, 199  
         *harrisi*, *Bullia*, 200  
         *subglobosa*, *Bullia*, 199  
     *altus*, *Buccitriton*, 191, 192  
     Alum Bluff group, 5, 20  
     *alveata*, *Architectonica*, 37, **151**, 152  
     *alveata*, *Cassidula* (*Lacinia*), 204  
     *alveata*, *Lacinia*, 205  
     *alveata*, *Melongena*, 204  
     *alveatum*, *Solarium*, 151  
     *alveatus*, *Conus*, 254

\*The index covers all references to species and the stratigraphic terms and critical localities cited in the Introduction but not those cited in the Systematic discussions. The boldfaced page number indicates the description or discussion of the genus or species.



- alveatus*, *Conus* (*Leptoconus*), 38, **254**  
*Alveinus*, 99  
*amadis*, *Conus*, 251  
*Amaurellina*, **177**  
*Amaurellina singleyi*, 36, **177**, pl. 13, figs. 1, 4;  
     pl. 14, fig. 8  
     sp. cf. *A. singleyi*, 14  
*Amauroopsis singleyi*, 177  
*ambiguus*, *Solen*, 111  
*americana*, *Glycymeris*, 51  
*amichel*, *Callocardia*, 117, 118  
*amichel*, *Callocardia* (*Agriopoma*), **116**  
*amichel*, *Ficus*, 36, **183**, 184  
*amichel*, *Hesperiturris*, 36, **238**, 239  
*amichel*, *Ostrea contracta*, 80, **81**, 82  
*amoena*, *Architectonica*, 151  
*amphora*, *Ampullina*, 38, **176**  
*amphora*, *Natica*, 176  
*ampla*, *Voluta*, 218  
*Ampullina*, **174**, 177, 267  
*Ampullina amphora*, 38, **176**, Pl. 19, fig. 2  
     *crassatina*, 174, 176  
     *mississippiensis*, 175  
     *depressa?*, 174  
     *dumblei*, 10, 12, 36, **174**, 175  
     *fischeri*, 174, Pl. 19, fig. 1  
     *mississippiensis*, 17, 18, 38, **175**, 176, Pl.  
         10, figs. 18, 23  
     *quitrinensis*, 36, **175**, Pl. 13, figs. 2, 3, 6, 7, 8  
     *recurva dumblei*, 174  
     sp. cf. *A. amphora*, 19  
     *spirata*, 177  
*Ampullina* (*Ampullina*), 174  
*Ampullinopsis*, **174**  
*Amusium*, **69**, 70  
*Amusium papyraceum*, 69  
*Amusium* (*Parvamussium*)? sp., **70**  
*Anadara*, **54**  
*Anadara chiriquiensis*, 55  
     *deussenii*, 55  
     *rhomboidella*, 55  
     *santarosana*, 54, 55  
         *geraetera*, 55  
     sp., **54**  
     sp. cf. *A. santarosana*, **54**  
     sp. cf. *A. vauhani*, **55**  
     *vauhani*, 55  
     *waltonia*, 55  
Anatinacea, 85  
*anatipes*, *Pecten*, 62  
*Anchura*, 170  
*Ancilla*, **218**  
*Ancilla scamba*, 218  
     sp., **218**  
     *staminea punctulifera*, 219  
     *subglobosa*, 199  
*Ancillaria*, 199, 218  
*Ancillaria candida*, 218  
     *staminea*, 219  
     *subglobosa*, 199  
*Ancillopsis*, **199**, 200  
*Ancillopsis altilis*, 195, 199  
     *harrisi*, 36, **200**, Pl. 22, figs. 22, 23  
     *patula*, 199  
     *subglobosa*, 37, **199**, Pl. 22, figs. 20, 21  
     *subglobosa?*, 16  
*Ancillopsis?* sp., **200**  
*angelinae*, *Tornatina*, 261  
*angeloi*, *Texmelanatria*, **157**  
*angulatus*, *Cyclops*, 144  
*angulifera*, *Lucina* (*Divaricella*), 96  
*annectens*, *Acteon*, 259  
*annosus*, *Surculites*, 231  
*Anodontia*, **94**  
*Anodontia alba*, 94  
*Anodontia?* *subvexa*, **94**, 95  
*Anomalodesmacea*, 85  
*Anomia*, **71**  
*Anomia ahippioides* (error for *ephippioides*), 73  
     *ephippioides*, 36, 72, **73**, 74, Pl. 1, figs. 16, 18  
         *lisbonensis*, 72  
     *ephippium*, 71  
     *floridana*, 74  
     *hammetti*, 73, 74  
     *lisbonensis*, 72, 73, 74  
     *malinchae*, 34, **72**, Pl. 5, Figs. 1, 2  
     *malinchae?*, **72**  
     *microgrammata*, 74  
     *navicelloides*, 73  
         *hammetti*, 73  
     *ruffini*, 74  
     *sellardsi*, 73  
     *simplex*, 74  
     sp., 8, **72**  
     sp. cf. *A. floridana*, **74**  
     sp. cf. *A. hammetti*, **73**  
     sp. cf. *A. lisbonensis*, **72**  
Anomiacea, 71  
Anomiidae, 71  
*Antalis*, **141**  
*antepruduca*[t]a, *Sphaerella*, 98  
*antepruduca*, *Diplodonta* (*Sphaerella*), **98**  
*antepruduca*, *Sphaerella?*, 98  
*antestriata*, *Crassatella*, 90, 91  
*antestriatus*, *Crassatellites*, **90**, 91  
*Antiguastrea cellulosa*, 18  
*antiguensis*, *Hemisinus*, 155  
*antiquata*, *Arca*, 54  
*antiquata*, *Littorina*, 149  
*antiquata*, *Tuba*, 150  
     *striata*, *Tuba*, 150  
     *texana*, *Tuba*, 150



- aperta*, *Natica*, 170  
*aperta*, *Natica* (*Gyrodus*), 170  
*aphippioides*, *Anomia*, 73  
*Apolymetis*, 107, 108  
*Apolymetis* sp., 108  
Aporrhaid, 34  
Aporrhaidae, Genus and species ind., 164  
Aquia formation, 7  
*Arca*, 53, 55  
*Arca antiquata*, 54  
    *barbata*, 52  
    *chiriquiensis*, 54  
    *cuculloidis*, 53  
    *cuculloidis? ludoviciana*, 53  
    *domingensis*, 54  
    *fragilis*, 48  
    *glycymeris*, 50  
    *gradata*, 53  
    *mississippiensis*, 53  
    *nucleus*, 40  
    *pernula*, 43  
    *reticulata*, 54  
    *rhomboidella*, 55  
        *parsaba*, 55  
    *rhomboides*, 54  
    *rostrata*, 43  
    *squamosa*, 54  
    *vaughani*, 55  
    (*Acar*) *reticulata*, 54  
    (*Barbatia*) *cuculloidis ludoviciana*, 53  
Arcacea, 50  
*Architectonica*, 149, 150, 152  
*Architectonica acuta*, 153  
    *alveata*, 13, 36, 37, 151, 152, Pl. 14, figs. 17, 20, 21, 23  
    *amoena*, 151  
    *bellastriata*, 151  
    *elaborata*, 152, 153  
    *josephi*, 37, 152, 153, Pl. 14, figs. 19, 22  
    *meekana*, 153, Pl. 23, figs. 4-6  
    *nobilis*, 151  
    sp., 150  
    sp., 151, Pl. 14, figs. 15, 18  
    sp. cf. *A. alveata*, 12  
    sp. cf. *A. josephi*, 153, Pl. 14, fig. 16  
    sp. cf. *A. quadriseriata*, 20  
    (*Granosolarium*) *acuta*, 153  
Architectonicidae, 149, 150  
Arcidae, 51  
Arcinae, 52  
*arenaria*, *Serpula*, 154  
*arenicola*, *Turritella*, 138  
*argentea*, *Atrina*, 61  
*argentea*, *Pteria*, 59  
*Argobuccinum*, 188  
*argus*, *Ranella*, 188  
*armigera*, *Cornulina*, 36, 202, 203, 214  
    *heilpriniana*, *Cornulina*, 214  
*armigera*, *Cornulina minax*, 202  
*armigera*, *Cornuliria*, 202  
*armigera*, *Melongena*, 202  
*armigera*, *Melongena?*, 202  
*armigera*, *Pseudoliva* (*Monoceros*), 202  
*armigerus*, *Monoceros*, 201, 202  
Arroyo Chacon, 12  
Arthropoda, 269  
*aruanus*, *Murex*, 205  
Aspidobranchia, 144  
Astartacea, 89  
*Astarte*, 89, 90  
*Astarte Conradi*, 112, 113  
    *tellinoides*, 89  
Astartidae, 89  
*astartoides*, *Callocardia*, 117, 175  
*Asthenotoma*, 243, 247  
*Asthenotoma cossmanni*, 247  
    *texana*, 244  
*atakta*, *Leda*, 48  
*atakta*, *Sacella*, 48, 49  
Atascosa County, 12, 15  
*Athleta*, 227  
*Athleta clayi*, 224, 225  
    *petrosa*, 225  
    *tuomeyi*, 228  
    *tuomeyi*, 227, 228  
    *wheelockensis*, 223  
*Atrina*, 60, 61  
*Atrina argentea*, 61  
    *gravidia*, 36, 60  
    *jacksoniana*, 16, 37, 61, Pl. 1, figs. ?10, ?15  
    sp., 60  
    sp., 61  
*Aturia*, 268  
*Aturia alabamensis*, 37, 38, 268  
*Aturia* sp., 36, 268  
*Aturia?* sp., 10  
Athyidae, 262  
*Atys*, 262, 265  
*Atys cymbulus*, 262  
*Atys* (*Aliculastrum*), 262  
*Atys?* (*Aliculastrum?*) sp., 262, Pl. 27, fig. 22  
*Aulacodiscus lissoni*, 166  
*aurantiacus*, *Latirus*, 211  
*Auricula ringens*, 260  
*auriculata*, *Ringicula*, 260  
*Avicula cardincrassa*, 59  
    *claibornensis*, 59  
    *limula*, 59  
Azara, 137  
*azucar*, *Corbula*, 131  
*azucar*, *Corbula* (*Varicorbula*), 37, 131



- babylonica*, *Cancellaria*, 230  
*bainbridgensis*, *Chione*, 124  
 Baker, C. L., 4  
 Baker, William A., Jr., v  
*bakeri*, *Cerastoderma*, 101, 102  
*bakeri*, *Cerastoderma (Dinocardium)*, 38, **101**, 102  
*Balanophyllia*, 80, 207  
*Balanophyllia irrorata*, 135  
     sp. cf. *B. irrorata*, 13  
*barbata*, *Arca*, 52  
*Barbatia*, **52**, 53, 54  
*Barbatia cuculoides*, 53  
     *domingensis*, 54  
     *ludoviciana*, 53  
     sp. cf. *B. domingensis*, 34, **54**  
     sp. cf. *B. ludoviciana*, 34, **53**  
*Barbatia (Acar) domingensis*, 54  
     *reticulata*, 54  
 Basal Laredo, 12  
 Bashi marl member, 5, 8  
*basteroti*, *Terebra*, 255  
*bastropensis*, *Callocardia*, 116, 117  
*bastropensis*, *Calorhadia*, 45  
*bastropensis*, *Calorhadia (Litorhadia)*, **46**  
*bastropensis*, *Falsifusus*, 36, **207**  
*bastropensis*, *Fusus*, 207  
*bastropensis*, *Leda*, 46  
*bastropensis*, *Meretrix trigoniata*, 116, 117  
*Bathytoma*, 248  
*Bathytoma (Glyptotoma) conradiana*, 248  
     *crassiplicata*, 248  
*beadata*, *Leptosurcula*, 237  
*beadata*, *Pleurotoma*, 236, 237  
*bella*, *Cochlespira*, **241**, 242  
*bella*, *Tornatellaea*, 259  
*bellastriata*, *Architectonica*, 151  
 Bells Landing horizon, 9  
 Belt, Ben C., 270  
 Bentonitic clay, 17, 18  
 Bibliography, 270  
*bidentata*, *Bulla*, 265  
*bidentata*, *Odostomia*, 146  
*bidentata*, *Turbonilla*, 146  
*bidentata*, *Turbonilla (Pyrgolamprus)*, 146  
 Bigford formation, 3, 10  
*bilineatum*, *Solarium*, 151  
*bilix*, *Sinum*, 178  
*bilix mississippiensis*, *Sigaretus*, 178  
*blastoides*, *Olivella*, 38, **218**  
*Bolis*, **194**  
*Bolis lisboa*, 194  
     *mexicana*, 36, **194**  
*Borsonia plena*, 197, 234, Pl. 25, figs. 3, 5  
*Borsonia (Scobinella) conradiana*, 248  
 Böse, Emil, 270  
 Böse, Emil and Cavins, O. A., 270  
*bouei*, *Trochopora*, 71  
 Bowles, Edgar, v, 270  
*Brachidontes*, **56**  
*Brachidontes mississippiensis*, 38, **56**  
     sp., 10  
     sp. cf. *Brachidontes texanus*, **56**  
     *texanus*, 56  
*Brachyodontes*, 56  
 Brantley, J. E., 270  
*brevidentata* var., *Cassidaria*, 180  
*brunnea*, *Natica*, 173  
 Buccinacea, 189, 207  
*Buccinanops*, 199  
 Buccinidae, 194  
 Buccininae, 204  
*Buccinum echinophorum*, 180  
     *migum*, 193  
     *mississippiense*, 190  
     *plumbeum*, 194  
     *sagenum*, 191  
     *strigilatum*, 257  
     *subulatum*, 255  
     *tectum*, 186  
*Buccitriton*, **191**, 192  
*Buccitriton altus*, 191, 192  
     *chapai*, 36, **192**, 193, Pl. 16, figs. 6, 8  
     *hilli*, 193  
     *hilli jacksonensis*, 16, 37, **193**  
     sp., 12  
     *texanus*, 36, **192**  
 Bulimulacea, 266  
*Bulinella*, 263  
*Bulla bidentata*, 265  
     *cylindracea*, 263  
     *cylindrica*, 262  
     *cylindroides*, 263, 264  
     *ficus*, 183  
     *Kellogii*, 264  
     *naucum*, 262  
     *umbilicata*, 266  
     (*Volvula*) *rostrata*, 261  
*Bullia*, 199, 200  
*Bullia altile*, 200  
     *altilis harrisi*, 200  
     *subglobosa*, 199  
*burdigalensis*, *Pyrula*, 182  
*burlesonensis*, *Chlamys*, **64**, 65  
*burlesonensis*, *Pecten*, 64  
*burlesonensis*, *Pecten (clarkeanus?* var.), 64  
*Busycon*, **205**, 206  
*Busycon muricatum*, 205  
     *spiniger*, **206**



- Busyconidae, 205  
 Byram limestone, 5  
*byramensis*, *Pecten*, 62, 63  
*byramensis*, *Pecten* (*Pecten*), 38, **62**, 63  
  
*cabezai*, *Cerastoderma*, 102  
*cabezai*, *Cerastoderma* (*Dinocardium*), 39, **102**  
*cabezai*, *Surculites*, 36, **232**, 233  
 Caddell clays, 17  
 Caddell member, 5  
*Cadulus*, **142**  
*Cadulus abruptus*, 143  
     *aldrichi*, 143, 144  
     *depressus*, 143  
     *jacksonensis*, 143  
     *newtonensis*, 143  
     sp., **142**  
     *subcoarctatus*, 142, 143  
     (*Gadila*?) *aldrichi*, 143  
         *aldrichi*?, 34, **143**  
     (*Polyschides*) *jacksonensis*, 37, **143**  
*Caestocorbula*, 127  
*cahobasensis*, *Ostrea*, 84, 85  
*calceola*, *Callocardia*, 119  
*calceola*, *Callocardia* (*Agriopoma*), 39, **119**  
*Callista*, 114  
*Callocardia*, 114, **116**, 120  
*Callocardia amichel*, 12, 13, 117, 118  
     *astartoides*, 10, 117, 175  
     *bastropensis*, 116, 117  
     *calceola*, 119  
     *guttata*, 116  
     *poulsoni*, 118  
     *prosayana*, 119  
     *pteleina*, 116, Pl. 4, fig. 6  
     sp. cf. *C. amichel*, 14  
     sp. cf. *C. securiformis*, 16  
     *texacola*, 117  
     *tornadonis*, 13, 118  
     (*Agriopoma*) *amichel*, 36, **116**, Pl. 9, figs. 26-29, 31  
         *calceola*, 39, **119**, Pl. 11, figs. 10, 11  
         *gatunensis*, 119  
         *securiformis*, 120  
         sp., **117**, **118**, **119**, Pl. 7, figs. 16, 20  
         sp. cf. *C. (A.) securiformis*, **120**  
         *texasiana*, 119  
         *tornadonis*, 36, **117**, Pl. 9, figs. 24, 25  
     (*Agriopoma*?) sp. cf. *C. pteleina*, **116**, Pl. 5, figs. 7, 12, 13  
*Calorhadia*, **44**, 45, 49  
*Calorhadia bastropensis*, 45  
     *compsa*, 46  
     *lisbonensis*, 45, 49  
     *mater*, 47  
     *media*, 47  
     *pharcida*, 45  
     *trumani*, 46  
     (*Litorhadia*) *bastropensis*, 36, **46**  
         *compsa*, 36, **45**  
         *lisbonensis*, 48, Pl. 1, fig. 7  
         *mater*, 37, **47**  
         *santa-anai*, 34, **45**, Pl. 5, fig. 9  
         sp., **45**, **46**, **47**, Pl. 1, fig. 8  
         sp. cf. *C. (L.) bastropensis*, 13  
         sp. cf. *C. (L.) lisbonensis*, 48  
*Calyptrea*, **163**  
*Calyptrea* sp., **163**  
*Calyptreaeacea*, 163  
*Calyptraeidae*, 163  
*Calyptrophorus*, **166**, 169  
*Calyptrophorus carrizensis*, 36, **167**, 168, Pl. 17, figs. 11, 18, 21; Pl. 27, fig. 26  
     *indicus*, 166  
     *Lamarkii*, 168  
     *popenoe*, 6, 34, **166**, 167, Pl. 17, fig. 10  
     sp., **167**  
     *trinodiferus*, 10, 167, 168  
     *velatus*, 36, 37, 167, **168**  
     *velatus* (*Rostellaria*), 168  
*Camptonectes* sculpture, 65  
 Canal zone, 19  
*canaliculatus*, *Murex*, 206  
*canaliculatus*, *Sycotypus*, 206  
*canalis*, *Rimella*, 165  
*canalis*, *Strombus*, 165  
*Cancellaria*, **229**, 230  
*Cancellaria babylonica*, 230  
     *panones*, 230  
*Cancellaria*? sp., **229**, Pl. 19, fig. 10  
*Cancellaria* (*Trigonostoma*) sp., **230**  
*Cancellariidae*, 229  
*cancellata*, *Cypraedia*, 178  
*cancellata*, *Nassa*, 191  
*cancellata*, *Venus*, 124  
*candida*, *Ancillaria*, 218  
*candida*, *Pholadomya*, 85  
 Cane River formation, 11  
*canrenoides*, *Gyrodes*, 170  
*canrenoides*, *Gyrodes* (*Sigaretopsis*), **170**  
*cantui*, *Macrocallista* (*Chionella*), 38, **115**  
*capa*, *Chlamys*, **65**, 66  
*capa jouda*, *Chlamys*, 65, **66**  
 Cardiacea, 99  
 Cardiidae, 99  
*cardincrassa*, *Avicula*, 59  
*Cardiomya*, **88**  
*Cardita beaumonti* beds, 166



- Cardita tetrica*, 93  
 Carditacea, 92  
*Cardium*, **99**, 100  
 "Cardium" beds, 5, 6  
*Cardium costatum*, 99  
     *diversum*, 105  
     *edule*, 100  
     *eversum*, 102  
     *graniferum*, 103  
     *isocardia*, 103  
     *magnum*, 101  
     *robustum*, 101  
     *semi-asperum*, 104  
     sp., 8  
     *ventricosum*, 101  
*carexus*, *Falsifusus*, 36, **208**, 209  
*carexus*, *Fusus mortoni*, 208  
 Caribbean region, 19  
*carica*, *Murex*, 205  
*Caricella*, **228**, 229  
*Caricella?* sp., **229**  
*Caricella subangulata?*, 16, 229  
*carinata*, *Pseudoliva*, 36, **197**, 198  
*carinata*, *Pseudoliva* (*Buccinorbis*), 197  
*carinata*, *Sulcobuccinum* (*Buccinorbis*), 197  
*carli*, *Corbula*, 133, 135, 136  
*carli*, *Corbula* (*Caryocorbula*), **136**  
*carli*, *Rimella*, 165, 166  
*carli*, *Rimella* (*Ectinochilus?*), 36, **165**  
*carlotae*, *Cerastoderma*, **100**  
*carlotae*, *Corbula*, 138  
*carlotae*, *Corbula* (*Erodona?*), 38, **137**  
*carlotae*, *Musculus*, **57**  
*carnaria*, *Tellina*, 108  
*carrizensis*, *Calyptrophorus*, 36, **167**, 168  
 Carrizo sand, 3, 5, 9, 10  
*carsonensis*, *Venericardia*, 94  
*Caryocorbula*, **132**  
*Cassidaria brevidentata* var., 180  
     *planotecta*, 180, 181  
     *striata*, 181  
 Cassididae, 179  
*Cassidula* (*Lacinia*) *alveata*, 204  
*Cassis*, 181  
*Cassis nuperus*, 181  
     (*Semicassis*) *shubutensis*, 180  
 Catahoula sandstone, 5  
 Catahoula tuff, 5  
*cataphractus*, *Murex*, 248  
*Catinus mississippiensis*, 178  
*caudata*, *Urosyca*, 182  
 Cavolinidae, 266  
*ceciliae*, *Pecten* (*Propeamussium*), 70  
*Celliforma*, **269**  
     *Celliforma germanica*, 269  
         *nuda*, 269  
*Celliforma?* sp., **269**, Pl. 10, figs. 5, 6  
*Celliforma spirifer*, 269  
*cellulifera*, *Fusimitra*, 220  
*cellulifera*, *Mitra*, 220  
 Cephalopoda, 268  
*Cerastoderma*, **100**  
*Cerastoderma bakeri*, 101, 102  
     *cabezai*, 102  
     *carlotae*, 5, 6, 34, **100**, Pl. 8, figs. 1-3  
     *chipolanum*, 101  
     *dominicense*, 102  
     *gatunense*, 102  
     sp., **100**, Pl. 8, figs. 5, 6  
     sp. cf. *C. waltonianum*, 20  
     *tuomeyi*, 100, 101, Pl. 8, figs. 4, 7-9  
     (*Dinocardium*) *bakeri*, 38, **101**, 102, Pl. 4,  
         figs. 11, 14  
     *cabezai*, 39, **102**, Pl. 4, figs. 7, 8, 10  
     sp., **102**  
     *taphrium*, 102  
*Cerastoderma* (*Dinocardium*)? sp., **102**  
 Cerithiacea, 153  
 Cerithidae, 156  
*Cerithium*, 10, **158**, 160, 162  
*Cerithium adansonii*, 158  
     *chipolanum*, 161  
     *elegans*, 159  
     *gemmatum*, 161  
     *giganteum*, 156  
     *hillsboroense*, 38, **159**, 160, Pl. 19, fig. 11  
     *mendezense*, 38, **160**, Pl. 19, figs. 7-9  
     *nodulosum*, 160  
     *parisiense*, 156  
     *revillense*, 36, **158**, Pl. 17, figs. 22, 23  
     sp., **159**, **160**  
     *texanum*, 156, 157  
     *thomasiae*, 161  
     *vinctum*, 158, Pl. 14, figs. 3, 7  
     *webbi*, 175  
     (*Ochetoclava*) *chipolanum*, 161  
         sp. cf. *C. (O.) chipolanum*, **161**  
*Cerithium?* *alejandroi*, 36, **158**, 159, Pl. 18, figs.  
     7, 8, 9, 12, 13  
     sp. cf. *C.?* *alejandroi*, **159**, Pl. 18, figs. 10, 11  
*Cernina*, 175  
*Ceronia singleyi*, 114  
*cerralvensis*, *Tornatellaea*, **259**  
*cerralvensis*, *Triliaria*, **190**  
 Cerralvo area, 4, 5, 6, 8  
*ceryx*, *Neverita limula*, 36, **172**, 173  
 Chaetopoda, 40  
*Chamelea*, **125**, 126



- chapai*, *Buccitriton*, 36, **192**, 193  
 Chapapote, 3  
 Chara fruits, 10  
*cherokeensis*, *Tellina*, 106  
 Chickasawhay limestone, 5, 17, 19  
*childreni*, *Coronia*, 237, 243  
*childreni*, *Pleurotoma*, 240  
*chinensis*, *Patella*, 163  
*Chione*, **124**, 126  
*Chione bainbridgensis*, 124  
     *craspedonia*, 125  
     *matulina*, 125, 126  
     *mississippiensis*, 125, 126  
     *spenceri*, 124  
     (*Chamelea*) *mississippiensis*, **125**  
         sp., 21  
     (*Chamelea*?) *matulina*, 38, **125**, Pl. 10, figs.  
         10, 12, 16  
     (*Chione*), **124**  
         sp. cf. *C. (C.) bainbridgensis*, **124**  
         *spenceri*, **124**  
         *spenceri*, 124  
*Chionella*, **114**, 115  
 Chipola formation, 5, 20  
*chipolana*, *Divaricella*, 97  
*chipolanum*, *Cerastoderma*, 101  
*chipolanum*, *Cerithium*, 161  
*chipolanum*, *Cerithium (Ochetoclava)*, 161  
*chipolanus*, *Murex (Murex)*, 188  
*chiriquiensis*, *Anadara*, 55  
*chiriquiensis*, *Arca*, 54  
*Chlamys*, **64**, 67  
*Chlamys burlesonensis*, 11, 36, **64**, 65  
     *capa*, 36, **65**, 66, Pl. 1, figs. 6, 9  
     *capa jouda*, 14, 36, 65, **66**, Pl. 1, fig. 17  
     *lyelli*, 65  
     *nicholsi*, 68  
         *neotera*, 68  
     *nupera*, 65, 66  
     sp., **66**  
     sp. cf. *C. burlesonensis*, 14  
         *nicholsi*, 20  
         *nupera*, **66**, Pl. 1, fig. 19  
     *thetidis*, 66  
     *wahtubbeana*, 65, Pl. 10, fig. 24  
     (*Aequipecten*) *plurinominis*, 67  
         sp. cf. *C. (A.) plurinominis*, **67**  
     (*Chlamys*) *nuperus*, 66  
     (*Lyropecten*) sp., **68**  
     (*Lyropecten*?) *nicholsi neotera*, 68  
*Chlamys (Lyropecten?)* sp. cf. *C. (L.) nicholsi*  
     *neotera*, 39, **68**, Pl. 11, figs. 7, 9  
     (*Nodipecten*) *dumblei*, 39, **69**, Pl. 11, figs.  
         4, 6  
     (*Plagiectenium*) *nicholsi*, 68  
*Chrysodomus*, 194  
*Cimomia*, 268  
*Cimomia vauhani*, 268  
*Cirsotrema*, **146**  
*Cirsotrema? cortezi*, 37, **147**, Pl. 15, fig. 18  
 Claiborne group, 5, 9  
*claibornensis*, *Avicula*, 59  
*claibornensis*, *Lithophaga*, 58  
*claibornensis*, *Pholadomya*, 86  
     *harrisi*, *Pholadomya*, **86**  
*clarkeanus*, *Pecten*, 64, 65  
*clarkeanus*, *Pecten (Chlamys)*, 64  
*clarkensis*, *Crassatellites*, 91, **92**  
     *ludoviciana*, *Crassatellites*, 92  
*Clava*, 161  
 "Clava" *plicifera*, 162  
*Clavella*, 209  
*Clavella (Fusus?) Penrosei*, 209  
*Clavilithes*, **209**, 210  
*Clavilithes penrosei*, 36, **209**, Pl. 13, fig. 5  
*Clavilithes?* sp., 13  
*clayi*, *Athleta*, 224, 225  
*clayi*, *Volutospina*, 36, **224**, 225  
 Clayton formation, 5  
*Clementia*, 85, **121**, 122  
*Clementia dariena*, 122  
     *solida*, 122  
     *vatheliti*, 122  
     (*Clementia*), 121  
     (*Egesta*) *grayi*, 122  
         sp. cf. *C. (E.) grayi*, 20, 39, **122**  
 Clydonautilidae, 268  
*cochlearis*, *Pleuroliria*, 246  
*cochlearis*, *Pleurotoma*, 245, 246  
*Cochlespira*, 234, **241**  
*Cochlespira bella*, 13, **241**, 242, Pl. 15, fig. ?15  
     *cristata*, 242  
     *engonata*, 241  
     sp., **242**, Pl. 25, fig. 6  
 Cocoa sand member, 5  
*coelata*, *Pleurotoma*, 242  
*coelata*, *Scobinella*, 249  
*cognata*, *Solarium*, 151  
*collaris*, *Pleurofusua*, 37, **244**, 245  
*collaris*, *Pleurotoma*, 244  
*coloradoensis*, *Corbula*, 132  
*coloradoensis*, *Corbula (Caryocorbula)*, 132  
 Cominellinae, 204  
*communis*, *Ficus*, 183  
*commutata*, *Nucula*, 48  
*compressa*, *Corbula*, 129  
     *gregorioi*, *Corbula*, 129  
*compressirostra*, *Ostrea*, 84  
*compsa*, *Calorhadia*, 46  
*compsa*, *Calorhadia (Litorhadia)*, 45



- compsa*, *Leda*, 45  
*compsa*, *Leda opulenta*, 45, 46  
*concava*, *Nucula*, 43  
*concentrica*, *Leda*, 44  
*conchyliophorus*, *Trochus*, 163  
*concinna*, *Cytherea*, 123  
Concretions, 4, 5, 10  
*condylomatus*, *Pecten*, 69  
*condylomatus*, *Pecten* (*Nodipecten*), 69  
Conidae, 250  
*Conomitra* (*Turricula*) *polita*, 220  
*Conorbis*, 254  
*conquisita*, *Fusimitra*, 220, 221, 222  
*conquisita*, *Mitra*, 220, 221, 222  
*conquisita*, *Mitra* (*Fusimitra*), 38, **222**  
Conrad, T. A., 270  
*Conradi*, *Astarte*, 112, 113  
*conradi*, *Corbula*, 130, 131, 133, 134, 136  
*conradi*, *Corbula* (*Caryocorbula*), **133**  
*conradi*, *Corbula* (*Cuneocorbula*), 133  
*conradi*, *Pteropsis*, 113  
*conradi*, *Thracia*, 86  
*conradiana*, *Bathytoma* (*Glyptotoma*), 248  
*conradiana*, *Borsonia* (*Scobinella*), 248  
*conradiana*, *Glyptotoma*, 248  
*conradiana*, *Scobinella*, 248  
*conradiana*, *Volvulella*, 262  
Contents, vii  
*contracta*, *Ostrea*, **81**, 82  
    *amichel*, *Ostrea*, 80, **81**, 82  
    *Ostrea alabamiensis*, 81  
*Conus*, **250**  
*Conus alveatus*, 254  
    *amadis*, 251  
    *haighti*, 252, 253, 254  
    *marmoreus*, 250  
    *protractus*, 254  
    *santander*, 13, 251, 252, 253, 254  
    *sauridens*, 251, 252, 254  
    *smithvillensis*, 251  
    sp., **255**  
    *spinosus*, 224  
    *tortilus*, 16, 252, 253, 254  
    (*Leptoconus*) *alveatus*, 38, **254**, Pl. 26, figs. 3, 11  
    *haighti*, 36, **252**, Pl. 26, figs. 2, 7  
    *santander*, 36, **251**, Pl. 26, figs. 5, 9, 10, 14  
    *smithvillensis*, 36, **251**  
    sp., **253**, Pl. 26, fig. 12  
    *tortilus*, 37, **253**, Pl. 26, figs. 1, 4, 6, 8, 13  
    (*Leptoconus*?) *protractus*, 38, **254**, Pl. 10, fig. ?22  
    (*Lithoconus*) *sauridens*, 251, 253  
    *smithvillensis*, 251  
Cook Mountain formation, 5, 11  
Cooke, C. Wythe, Gardner, Julia, and Woodring, Wendell P., 270  
*Corbula*, **126**, 127, 132, 137  
*Corbula alabamiensis*, 129, 132, 133, **134**  
    *aldrichi*, 132  
    *smithvillensis*, 128  
    *azucar*, 131  
    *carli*, 133, 135, 136  
    *carlotae*, 138  
    *coloradoensis*, 132  
    *compressa*, 129  
    *gregorioi*, 129  
    *conradi*, 13, 130, 131, 133, 134, 136  
    *engonata*, 135, 136  
    *engonatoides*, 13, 135, 136  
    *filosa*, 130  
    *gibba*, 127  
    *gibbosa*, 131, 132  
    *gregorioi*, 128, 129, 130, 133  
    *henckeliusi*, 127  
    *laqueata*, 130, 131  
    *mactriformis*, 137  
    *murchisoni*, 132  
    *nasuta*, 133  
    *nimbosa*, 138  
    *nucleus*, 127  
    *oniscus*, 132  
    *rugosa*, 128  
    *santanensis*, 134  
    *smithvillensis*, 10, 13, 128, 129, 130  
    sp. cf. *C. (Caryocorbula) conradi*, **134**  
    *subtrigonalis*, 137  
    *sulcata*, 127  
    *texana*, 127, 128, 157  
    *wailesiana*, 131, 132  
    (*Aloidis*) *perdubia*, 130  
    *texana*, 127  
    (*Caryocorbula*) *aldrichi*, 34, **132**, Pl. 8, fig. 12  
    *carli*, 37, **136**, Pl. 9, figs. 10, 15  
    *coloradoensis*, 132, Pl. 4, fig. 1  
    *conradi*, 36, **133**, Pl. 9, figs. 13, 16  
    *engonata*, 38, **136**  
    *engonatoides*, 36, **134**, Pl. 9, figs. 18, 19, 23  
    *santanensis*, 36, **134**, Pl. 9, fig. 20  
    sp. cf. *C. (C.) conradi*, **133**, **134**, Pl. 9, fig. 14  
    sp. cf. *C. (C.) engonata*, **135**, Pl. 9, fig. 6  
    (*Caryocorbula*?) sp., **134**  
    (*Cuneocorbula*) *alabamiensis*, 133  
    *conradi*, 133  
    *engonata*, 136  
    *gregorioi*, 128, 129



- (*Erodona?*) *carlotae*, 38, **137**, Pl. 4, fig. 9;  
Pl. 10, figs. 15, 19, 20  
(*Neaera*) *perdubia*, 130  
(*Potamomya*) *priscopsis*, 137  
(*Varicorbula*) *azucar*, 37, **131**, Pl. 4, fig. 13  
*gregorioi?*, 36, **129**, Pl. 9, figs. 11, 12  
*laqueata*, 38, **130**  
*smithvillensis*, 36, **128**, Pl. 9, figs. 2-4,  
7-9  
sp., 10, **131**, Pl. 9, fig. 17  
*texana*, 36, **127**, Pl. 9, figs. 1, 5  
Corbulidae, 126  
*corbuloidea*, *Thracia*, 86  
*Cordieria Moorei*, 211  
*corneoides*, *Eburneopecten scintillatus*, 65  
*Cornulina*, **201**, 202, 203, 204, 214, 215  
*Cornulina armigera*, 12, 13, 36, **202**, 203, 214,  
Pl. 20, figs. 2, 3, 7, 8; Pl. 21, fig. 1  
*heilpriniana*, 214  
*minax*, 201, Pl. 20, fig. 5  
*armigera*, 202  
*heilpriniana*, 214  
(*Revilla*) *lita*, 36, **203**, 204, Pl. 20, figs. 4, 6  
*Cornuliria armigera*, 202  
*coronalis*, *Scala*, 146  
*coronata*, *Voluta*, 227  
*Coronia*, 237, **240**, 241, 243  
*childreni*, 237, 243  
*genetiva?*, 14, **241**, Pl. 25, figs. 9, 11  
*margaritosa?*, 13, **240**, 241, Pl. 27, fig. 7  
*Coronia?* sp., **240**, Pl. 25, fig. 12  
*Coroniscala*, **146**  
Correlation of deposits in northeastern Mexico,  
5  
Correlation table, 5  
*cortezi*, *Cirsotrema?*, 37, **147**  
*cortezi*, *Surculites*, 36, **232**, 233  
*cortezi*, *Tubulostium*, **40**  
*corticata*, *Oliva*, 216  
*corvocada*, *Volutospina (Eoathleta)*, **227**  
*cossmanni*, *Asthenotoma*, 247  
*cossmanni*, *Pleurotoma*, 247  
*costatum*, *Cardium*, 99  
*costellatus*, *Actaeon*, 259  
*costulata*, *Turbonilla*, 145  
Coyote district, 6  
*cranchii*, *Abderospira*, 263  
*craspedonia*, *Chione*, 125  
*craspedota*, *Spisula (Hemimactra)*, 112  
*Crassatella*, 90  
*Crassatella alta*, 113  
*antestriata*, 90, 91  
*texana*, 91  
*Crassatellites*, 89, **90**  
*Crassatellites antestriatus*, 13, 36, **90**, 91, Pl. 6,  
figs. 7, 10, 11, 14; Pl. 7, figs. 9, 10  
*clarkensis*, 36, 91, **92**, Pl. 6, figs. 5, 13, 15, 16  
*ludoviciana*, 92  
*negreetensis*, 91  
*protextus*, 91, 92  
*sinuatus*, 90  
sp. cf. *C. clarkensis*, 14  
*texanus*, 36, **91**  
*trapaquarus*, 91  
*tumidulus*, 91, Pl. 6, fig. 6  
Crassatellitidae, 90  
*crassatina*, *Ampullina*, 174, 176  
*mississippiensis*, *Ampullina*, 175  
*crassatina*, *Natica*, 175  
*crassi-cornuta*, *Melongena*, 201, 202  
*crassiplicata*, *Bathytoma (Glyptotoma)*, 248  
*crassiplicata*, *Glyptotoma*, 36, **248**  
*crassiplicata*, *Scobinella*, 248  
*crenata*, *Natica (Gyrodes)*, 170  
*creno-carinata*, *Eucheilodon*, 249, 250  
*Crepidula*, 163  
*cristata*, *Cochlespira*, 242  
"Crockett marl", 13  
*crockettensis*, *Volutocorbis lisbonensis*, 223  
*Crucibulum*, 163  
*cubanians*, *Hemisinus*, 155  
*cuculoides*, *Arca*, 53  
*cuculoides*, *Barbatia*, 53  
*ludoviciana*, *Arca (Barbatia)*, 53  
*Cuma*, 186  
*cumingii*, *Jouannetia*, 139  
*Cuneocorbula*, 132  
*curvicosta*, *Eopleurotoma*, 237  
*curvirostratus*, *Typhis*, 38, **189**  
*Cuspidaria*, **88**  
*Cuspidaria prima*, 88, 89  
*vieja*, 88, 89  
(*Cardiomya*) *vieja*, 34, **88**, Pl. 5, fig. 8  
Cuspidariidae, 88  
*cuspidata*, *Tellina*, 88  
*Cuviera*, 266  
*cuvieri*, *Lemintina*, 154  
*Cuvierina*, 266  
*Cyathodonta*, **87**, 88  
*Cyathodonta undulata*, 87  
*Cyclas subvexa*, 95  
*Cyclomolops vredenburgi*, 166  
*Cyclops angulatus*, 144  
*cygnea*, *Mactra*, 90  
*Cylichna*, **263**, 264  
*Cylichna agatha*, 265  
*galba*, 265  
*jacksonensis*, 265



- kellogii*, 264, 265  
 (*Acrotrema*) *agatha*, 36, **264**, Pl. 27, figs. 32, 33  
*kellogii*, 36, **264**, Pl. 27, fig. 27  
 sp. cf. *C. (A.) jacksonensis*, **265**, Pl. 27, fig. 31  
 sq. cf. *C. (A.) kellogii*, **264**, Pl. 27, fig. 30  
*Cylichnella*, **265**  
*Cylichnella* sp., **265**  
*Cylichnina*, 263, 264, **265**, 266  
*Cylichnina kellogii*, 264  
 sp., **266**  
*Cylichnus*, 263  
*cylindracea*, *Bulla*, 263  
*cylindrica*, *Bulla*, 262  
*cylindroides*, *Bulla*, 263, 264  
*Cymatiidae*, 184  
*cymbulus*, *Alys*, 262  
*Cymia*, **186**  
*Cymia* sp., **186**  
*Cypraea elegans*, 178  
*lintea*, 179  
*Cypraeacea*, 178  
*Cypraedia*, **178**, 179  
*Cypraedia cancellata*, 178  
*gilberti*, 179  
*multicarinata*, 179  
 sp., **179**, Pl. 17, figs. 1, 2-4, 5, 6, 16, 17  
*subcancellata*, 179  
*Cypraeidae*, 178  
*Cytherea concinna*, 123  
*mississippiensis*, 125  
*Nuttali*, 116  
*ovalina*, 115  
*securiformis*, 120  
*texacola tornadonis*, 117  
*texasiana*, 116  
*tornadonis*, 117  
  
*dactylus*, *Lithodomus*, 57  
*dalli*, *Mazzalina*, 214  
*dama*, *Olivella*, 217  
*dariena*, *Clementia*, 122  
*declive*, *Sinum*, 178  
*declivis*, *Halonanus*, **52**  
*declivis*, *Limopsis*, 52  
*declivis*, *Pectunculus*, 52  
*declivis*, *Trinacria*, 52  
*decussata*, *Scalaria*, 147  
*Delphinula trigonostoma*, 230  
*densa*, *Spisula (Hemimactra)*, 112  
*Dentaliidae*, 141  
*dentalina*, *Ditrupea*, 144  
*Dentalium*, **141**, 142  
  
*Dentalium elephantinum*, 141  
*entalis*, 142  
*gadus*, 143  
*mediaviense*, 141  
*minutistriatum*, 141  
*mississippiense*, 142  
*mississippiensis*, 142  
*ovulum*, 142  
 sp. **141**  
 sp. cf. *D. minutistriatum*, 36, **141**  
*thalloides*, 142  
*turritum*, 143  
 (*Antalis*) *mississippiense*, 37, 38, **142**  
*depressa?*, *Ampullina*, 174  
*depressus*, *Cadulus*, 143  
*deshayesii*, *Pecten*, 64  
*deussenii*, *Anadara*, 55  
*deussenii*, *Pteria*, 59  
 Dickerson, Roy E. 270  
 Dickerson, Roy E. and Kew, W. S. W., 270  
*diga*, *Perissolax*, **183**  
*diga*, *Venericardia*, 77  
*digitalina*, *Volutilithes*, 222  
*Diluvarca*, 54  
*Dinocardium*, **101**  
*Dione securiformis*, 120  
*dione*, *Venus*, 123  
*Diplodonta*, **97**  
*Diplodonta turgida*, 98  
 (*Sphaerella*) *anteproducta*, 36, **98**, Pl. 7, figs. 2, 5  
*Diplodontidae*, 97  
*Discocyclina weaveri*, 7  
*parvipapillata*, 7  
*Discocyclinid zone*, 11, 40, 92, 96, 126, 163  
*discors*, *Musculus*, 57  
*discors*, *Mytilus*, 57  
*Distorsio septemdentata*, 185  
*Distortio septemdentata*, 185  
 (*Personella*) *septemdentata*, 184, 185  
*Distortrix septemdentata*, 185  
 Distribution of species mostly Mollusca in the Claiborne group, 36  
 Distribution of the Mollusca in the Jackson formation, 37  
 Distribution table of the Mollusca in the lower Eocene, 34, 35  
 Distribution of the Mollusca in the Miocene, 39  
 Distribution of the Mollusca in the Oligocene, 38  
*Ditrupea dentalina*, 144  
*subcoarctuata*, 142, 143  
*Divaricella*, **96**, 97, 108  
*Divaricella chipolana*, 97  
*subrigaultiana*, 97  
 sp. 19, **96**, **97**



- diversa*, *Protocardia*, 105  
*diversidentata*, *Venericardia*, 93  
*diversum*, *Cardium*, 105  
*diversum*, *Nemocardium*, 38, **105**  
*divisura*, *Terebra*, 257  
*divisurum*, *Terebra*, 255, 257  
Doliacea, 179  
*dominicense*, *Cerastoderma*, 102  
*domingensis*, *Arca*, 54  
*domingensis*, *Barbatia*, 54  
*domingensis*, *Barbatia* (*Acar*), 54  
*donacia*, *Mactra*, 113  
Donacidae, 110  
*Donax*, **110**  
*Donax funerata*, 110  
    *rugosa*, 110  
    sp., **110**  
*Drillia nodocarinata*, 238  
Dumble, E. T., 3, 20, 270  
*dumblei*, *Ampullina*, 36, **174**, 175  
*dumblei*, *Ampullina recurva*, 174  
*dumblei*, *Chlamys* (*Nodipecten*), 39, **69**  
*dumblei*, *Natica*, 174  
*dumblei*, *Nodipecten*, 69  
*dumblei*, *Surculoma*, 242  
*duodecim-lamellatus*, *Pecten*, 70  
Duplin marl, 5  
*dysera*, *Venus*, 124
- East Texas, 11  
*eborea*, *Gari*, 109  
*eborea*, *Gari* (*Psammacola*), 109  
*eborea*, *Leda*, 43, 44  
*eborea*, *Leda* (*Yoldia*), 44  
*eborea*, *Nucula*, 43, 44  
*eborea*, *Psammobia*, 109  
*eborea*, *Yoldia*, 44  
*Eburneopecten scintillatus corneoides*, 65  
*echinophorum*, *Buccinum*, 180  
*Ectinochilus*, **165**, 166  
*Ectinochilus texanus*, 164  
    (*Macilentos*) *texanus*, 164  
*edentula*, *Venus*, 94  
*edule*, *Cardium*, 100  
*edulis*, *Ostrea*, 75  
Egesta, **122**  
*elaborata*, *Architectonica*, 152, 153  
*elegans*, *Cerithium*, 159  
*elegans*, *Cypraea*, 178  
*elephantinum*, *Dentalium*, 141  
*elevata*, *Fasciolaria*, 220  
*elliptica*, *Pseudoliva*, 195  
*elongatoidea*, "Leda", 45  
*eminula*, *Natica*, 174
- Emory, W. H., 270  
*Enclimatoceras*, 268  
*Enclimatoceras vauhani*, 268  
*engonata*, *Cochlespira*, 241  
*engonata*, *Corbula*, 135, 136  
*engonata*, *Corbula* (*Caryocorbula*), 38, **136**  
*engonata*, *Corbula* (*Cuneocorbula*), 136  
*engonata*, *Surculites*, 232  
    *exoleta*, *Surculites*, 233  
*engonatoides*, *Corbula*, 135, 136  
*engonatoides*, *Corbula* (*Caryocorbula*), **134**  
*engonatus*, *Fusus* (*Hemifusus*?), 232  
*entalis*, *Dentalium*, 142  
*Eoathleta*, **227**  
Eocene series, 5, 7  
*eocensis*, *Perissolax*, 183  
*Eopleurotoma*, 237  
*Eopleurotoma curvicosta*, 237  
    *multicostata*, 237  
    *nodocarinata*, 238  
*eosilicata*, *Hemisurcula*, **247**  
*Eosolen*, **111**  
*Eosurcula*, 234, **235**  
*Eosurcula moorei*, 13, 36, **235**, 236, Pl. 25, fig. 2; Pl. 27, fig. ?17  
    *moorella*, 236  
*eothersae*, *Ostrea*, **75**, 77  
*ephippioides*, *Anomia*, 72, **73**, 74  
    *lisbonensis*, *Anomia*, 72  
*ephippium*, *Anomia*, 71  
Epitoniidae, 146, 149  
Epitoniidae?, 149  
*Epitonium* (*Ferminoscala*) *ferminianum*, 147  
*Erodina*, 137  
*erodina* (error for *erodona*), *Mya*, 137  
*Erodona*, 18, **137**, 138, 267  
*Erodona mactroides*, 137, 138  
*errans*, *Surculites*, 231  
*escandoni*, *Scalina*, 39, **148**, 149  
*estrellanus*, *Lyropecten*, 67  
*Eucheilodon*, **249**, 250  
*Eucheilodon creno-carinata*, 249, 250  
    *reticulata*, 249  
    sp. cf. *E. creno-carinata*, **250**, Pl. 27, fig. 26  
*Eupatagus*, 19  
*euplecta*, *Plicatula*, **71**  
*Euthyneura*, 258  
*Euvola*, 62  
*eva*, *Holospira*, 38, **266**  
*eversum*, "Cardium", 102  
*Exogyra costata* zone, 170  
*Exogyra ponderosa* zone, 170  
*exoleta*, *Surculites engonata*, 233



- falco*, *Ostrea*, 77  
*Falsifusus*, **206**, 207  
*Falsifusus bastropensis*, 36, **207**  
     *carexus*, 12, 13, 36, **208**, 209, Pl. 27, fig. 11  
     *meyeri*, 207  
     *mortoniopsis*, 13, 36, 197, **208**, 209, Pl. 27, fig. 18  
     sp., **207**  
*Fasciolaria*, 213, **215**  
*Fasciolaria elevata*, 220  
     *moorei*, 211  
     *plicata*, 212  
     *polita*, 220  
*Fasciolaria?* sp., **215**, Pl. 15, figs. 11, 12, 16  
Fasciolariidae, 207, 210, 211  
*ferminiana*, *Scala*, 147  
*ferminianum*, *Epitonium* (*Ferminoscala*), 147  
*Ferminoscala*, 147  
*ferröensis*, *Tellina*, 109  
*fervensis*, *Tellina*, 109  
Ficidae, 182  
*Ficus*, **183**  
*Ficus amichel*, 36, **183**, 184  
     *communis*, 183  
     *filia*, 184  
     *intermedia*, 182  
     *mississippiensis*, 18, 19, 38, **184**  
     *papyratia*, 184  
     *picta*, 183  
     sp., **184**  
     *variegata*, 183  
*ficus*, *Bulla*, 183  
*ficus*, *Murex*, 183  
*filamentosa*, *Plicatula*, 71  
*filia*, *Ficus*, 184  
*filosa*, *Corbula*, 130  
*filosus*, *Murex*, 211  
*fischeri*, *Ampullina*, 174  
*fissurella*, *Rimella*, 165  
*fissurella*, *Rostellaria*, 164  
*Flabellum*, 80  
*Flabellum cuneiforme*, 13  
*flaminea*, *Mitrella*, 189  
Flint River formation, 5  
Florida, 5  
*floridana*, *Anomia*, 74  
*fragilis*, *Arca*, 48  
*Fragum*, 103, 104  
*francesae*, *Jouannetia*, **139**  
Frio clay, 5, 17  
*frionis*, *Ostrea*, 82  
*frithi*, *Ostrea*, **82**, 83  
*Fulgur*, 209  
*Fulgur spiniger*, 206  
*Fulguroficus*, **182**  
*funerata*, *Donax*, 110  
*funerata*, *Spisula*, 112  
*fusiformis*, *Polygona*, 211  
*fusiformis*, *Pseudoliva*, 197  
*Fusimitra*, **220**, 221  
*Fusimitra cellulifera*, 220  
     *conquisita*, 220, 221, 222  
     *polita*, 220  
*Fusimitra?* *lineata*, 220  
     *minima*, 220  
     *perexilis*, 220  
Fusinidae, 206, 207  
*Fusus*, 207  
*Fusus bastropensis*, 207  
     *ludovicianus*, 207  
     *meyeri*, 206, 207  
     *minax*, 201  
     *mortoni*, 208, 209  
         *carexus*, 208  
         *mortoniopsis*, 208, 209  
     *mortoniopsis*, 208, 209  
     *Noae*, 209  
     *ottonis*, 206  
     *spiniger*, 206  
     *Taitii*, 202  
     (*Hemifusus?*) *engonatus*, 232  
     "*Fusus*" sp., 183  
  
*gabbi*, *Pleurotoma*, 233  
*gabbi*, *Pleurotoma* (*Surcula*), 234  
*gabbi*, *Protosurcula*, 234  
*gabbi*, *Surcula*, 234  
*gabbi*, *Turricula*, 234  
*gabbii*, *Pleurotoma*, 234  
*gabbii*, *Pleurotoma* (*Surcula*), 234  
*gabbii*, *Protosurcula*, 36, **234**, 235  
*gabbii*, *Surcula*, 234  
*Gadila*, **143**, 144  
*Gadilopsis*, 144  
*gadus*, *Dentalium*, 143  
*galba*, *Cylichna*, 265  
*Galeodea*, **180**, 181  
*Galeodea koureos*, 8, 9, 34, 77, **180**  
     *planotecta*, 36, **181**  
     sp., 9, 34, **180**  
     (*Galeodaria*) *petersoni*, 180  
     (*Mambrinia*) *koureos*, 180  
         *planotecta*, 181  
         sp., 180  
*Galeodea?* *shubutensis*, **180**  
     sp., **180**  
*gallina*, *Venus*, 125, 126  
*gambrina*, *Protocardia*, 105



- Gardner, Julia, 270  
 Gardner, Julia and Bowles, Edgar, 270  
 Garfias, V. R., 270  
 Gari, 108, 110  
 Gari *eborea*, 109  
     sp. cf. *G. eborea*, 109, Pl. 7, figs. 1, 3  
     *vulgaris*, 109  
     (*Psammacola*) *eborea*, 109  
 gari, *Tellina*, 109  
 Garidae, 108  
 garzai, *Mitrella*, 36, 189  
     *Volvulella*, 37, 261, 262  
 Gastropoda, 144  
 gatunense, *Cerastoderma*, 102  
 gatunensis, *Callocardia* (*Agriopoma*), 119  
 gatunensis, *Terebra*, 257  
 gaultina, *Nucula*, 41  
 Gegania, 149  
 Gegania *pinguis*, 149  
     *texana*, 150  
     *texana?*, 36, 150, Pl. 15, figs. 14, 17  
 gemmata, *Gemmula*, 240  
 gemmatum, *Cerithium*, 161  
 Gemmula, 237, 240  
 Gemmula *gemma*, 240  
     *genetiva*, 241  
     *rotaedens*, 241  
     *genetiva*, *Coronia*, 241  
     *genetiva*, *Gemmula*, 241  
     *georgiana*, *Ostrea*, 81, 84  
     *georgiana*, *Ostrea alabamensis*, 81  
         *normalis*, *Ostrea*, 84  
     *geraetera*, *Anadara santarosana*, 55  
     *germanica*, *Celliforma*, 269  
 Getzendaner, F. M., 270  
 gibba, *Corbula*, 127  
 gibbosa, *Corbula*, 131, 132  
 gibbulus, *Murex*, 211  
 Gierhart, Guy B., 3  
 gierharti, *Ostrea*, 78, 79  
 gigantea, *Venus*, 114  
 giganteum, *Cerithium*, 156  
 Gigantopecten, 67  
 gilberti, *Cyprædia*, 179  
 Glossaulax, 173  
 glycymeris, *Mya*, 138  
 Glycymeridae, 50  
 Glycymeris, 50  
 Glycymeris *americana*, 51  
     *mississippiensis*, 51  
     *orbicularis*, 50  
     sp. cf. *G. mississippiensis*, 51, Pl. 10, fig. 17  
     *staminea*, 51  
 glycymeris, *Arca*, 50  
 Glyphostoma, 247  
 Glyphostoma *harrisi*, 247, 248  
 Glyptotoma, 248  
 Glyptotoma *conradiana*, 248  
     *crassiplicata*, 36, 248  
 Goniobasis, 157  
 Goniobasis *texana*, 157  
 gouldiana, *Neaera*, 88  
 gradata, *Arca*, 53  
 grande, *Lithophysema*, 263  
 grandis, *Haminea*, 262  
 graniferum, *Cardium*, 103  
 Granosolarium, 152  
 granulatum, *Solarium*, 151  
 grvida, *Atrina*, 60  
 grvida, *Pinna*, 60  
 grayi, *Clementia*, 122  
 grayi, *Clementia* (*Egesta*), 122  
 gregorioi, *Corbula*, 128, 129, 130, 133  
 gregorioi, *Corbula compressa*, 129  
 gregorioi, *Corbula* (*Cuneocorbula*), 128, 129  
 gregorioi, *Corbula* (*Varicorbula*), 129  
 Gryphaea *thirsae*, 76  
 Guadalupe, treaty of, 1, 4  
 Guajalote formation, 5, 19, 20, 21  
 Guerras, el rancho de las, 3  
 Guerrero, 10, 11  
 guineensis, *Aloidis*, 127  
 guttata, *Callocardia*, 116  
 Gymnoglossa, 145  
 Gyrodes, 169, 170  
 Gyrodes *canrenoides*, 170  
     *rugifera*, 170, 171  
     (*Sigaretopsis*) *aperta*, 170, Pl. 14, fig. 9  
     (*Sigaretopsis*) *canrenoides*, 34, 170, Pl. 15,  
         figs. 1-4, ?7, ?8  
 Haight, Harold, v  
 highti, *Conus*, 252, 253, 254  
 highti, *Conus* (*Leptoconus*), 36, 252  
 hailensis, *Ostrea*, 82  
 haleanus, *Volutocorbis?*, 224  
 haliotoidea, *Helix*, 178  
 Halonanus, 51  
 Halonanus *declivis*, 36, 52, Pl. 1, fig. ?11  
     *pulchrus*, 36, 51, 52, Pl. 1, figs. ?2, ?4;  
         Pl. 7, fig. ?13  
 Haminea *grandis*, 262  
 hammetti, *Anomia*, 73, 74  
 hammetti, *Anomia navicelloides*, 73  
 Hamulus, 40  
 harrisi, *Ancillopsis*, 36, 200  
 harrisi, *Bullia altile*, 200  
 harrisi, *Bullia altilis*, 200



- harrisi*, *Glyphostoma*, 247, 248  
*harrisi*, *Microdrillia*, 36, **247**, 248  
*harrisi*, *Pholadomya claibornensis*, **86**  
*harrisi*, *Pitaria*, 124  
*harrisii*, *Polinices*, 174  
*Hastula*, 256, **257**, 258  
*Hastula?* *houstonia*, 36, 257, **258**  
Hatchetigbee formation, 5  
*heilpriniana*, *Cornulina armigera*, 214  
*heilpriniana*, *Cornulina minax*, 214  
*heilpriniana*, *Mazzalina?*, **214**  
*pyrobola*, *Mazzalina?*, 36, **214**  
Helicacea, 267  
*Helix*, 18  
*Helix haliotoidea*, 178  
"Helix" sp., 38, **267**, Pl. 18, figs. 1-3  
*Hemisinus*, 18, **154**, 267  
*Hemisinus antiguensis*, 155  
*cubanianus*, 155  
*miralejas*, 38, **155**, Pl. 16, figs. 12, 15  
*siliceus*, 155  
*mexicanus*, 38, **155**, Pl. 16, fig. 13  
*spica*, 155  
*tuberculata*, 154  
*Hemisurcula*, **246**, 247  
*Hemisurcula eosilicata*, 35, **247**, Pl. 25, fig. 4  
*silicata*, 247, Pl. 25, figs. 19, 20  
*henckeliusi*, *Corbula*, 127  
*Hercoglossa*, **268**  
*Hercoglossa* sp. cf. *H. vaughani*, 35, **268**, Pl. 5, fig. 5  
*vaughani*, 6, 268  
*Hesperiturris*, **237**, 238, 240  
*Hesperiturris amichel*, 12, 14, 36, **238**, 239, Pl. 25, figs. 1, 10, 16  
*nodocarinata*, 237, **238**, Pl. 24, figs. 3, 4; Pl. 25, fig. 7; Pl. 27, fig. 13  
*zacatensis*, 37, **239**, Pl. 24, figs. 2, 5  
Hill, Robert T., 3, 270, 271  
*hilli*, *Buccitriton*, 193  
*hilli jacksonensis*, *Buccitriton*, 37, **193**  
*hilli jacksonensis*, *Phos*, 193  
*hillsboroense*, *Cerithium*, 38, **159**, 160  
*hillsboroensis*, *Cerithium*, 159  
*hillsboroensis*, *Potamides*, 159  
*Hippochrenes*, 168  
*hirundo*, *Mytilus*, 58  
Historical background, 1  
*hodgii*, *Sconsia*, 181  
*Holospira*, 18, **266**, 267  
*Holospira eva*, 38, **266**, Pl. 10, fig. 21  
*houstonia*, *Hastula?*, 36, 257, **258**  
*houstonia*, *Terebra*, 257, 258  
*houzeaui*, *Rostellaria*, 166  
Huasteca Petroleum Company, 20  
*huppertzi*, *Pleurotoma*, 242  
Hymenoptera, 269  
*Hysteroconcha*, **123**  
  
*Idioraphe*, **144**  
*imbricata*, *Venericardia*, 92  
*imbricata*, *Venus*, 92  
*impressa*, *Volutospina*, 225  
*inaequalis*, *Terebra*, 257  
*inaurata*, *Mazzalina*, 213  
Incertae sedis, **50**, **58**, **89**, **109**, **110**, **112**, **119**, **120**, **121**, **126**, **149**, **161**, **176**, **186**, **188**, **216**, **258**, Pl. 5, fig. 14; Pl. 7, figs. 4, 12, 15; Pl. 9, figs. 21, 22, 30; Pl. 15, fig. 13; Pl. 18, fig. 4  
*inconstans*, *Sinum*, 178  
*incrassata*, *Teredo* (*Kuphus*), 140  
*incrassata*, *Teredo?*, 141  
*incrassatus*, *Kuphus*, 38, **140**  
*indenta*, *Volutospina*, 225  
*indicus*, *Calyptrophorus*, 166  
Indio formation, 5, 7  
lower, 5, 8  
middle, 5, 8  
upper, 5, 8, 9  
*infans*, *Pleurotoma*, 247, 248  
*inflata*, *Sphaerella*, 98  
*infundibulum*, *Murex*, 211  
*infundibulum*, *Natica*, 170  
*inoceriformis*, *Venus*, 122  
*inornatus*, *Orthaulax*, 169  
Insecta, 269  
*insularis*, *Ostrea vaughani*, 84, 85  
*intermedia*, *Ficus*, 182  
*intermedoides*, *Ostrea*, 77, 78  
*irrorata*, *Balanophyllia*, 135  
*islandicus*, *Pecten*, 64  
*isocardia*, *Cardium*, 103  
  
Jackson formation, 5, 16, 17  
lower, 5  
middle, 5  
upper, 5  
Jackson group, 5  
*jacksonensis*, *Buccitriton hilli*, 37, **193**  
*jacksonensis*, *Cadulus*, 143  
*jacksonensis*, *Cadulus* (*Polyschides*), 37, **143**  
*jacksonensis*, *Cylichna*, 265  
*jacksonensis*, *Phos hilli*, 193  
*jacksonensis*, *Venericardia*, 93  
*jacksoniana*, *Atrina*, 37, **61**  
*jamaicensis*, *Lucina*, 95  
Jones, Richard A., 271



- josephi*, *Architectonica*, 37, **152**, 153  
*Josephina*, **246**  
*josephinia*, *Neverita*, 172  
*Jouannetia*, **138**, 139  
*Jouannetia cumingii*, 139  
     *francesae*, 36, **139**, Pl. 8, fig. 10  
     *semicaudata*, 139  
*jouda*, *Chlamys capa*, 65, **66**  
*Jupiteria*, 43  
*juvenis*, *Priscoficus*, 182  
*juvenis*, *Priscoficus* (*Fulguroficus*), **182**  
*juvenis*, *Pyrula*, 182
- Kane, William G., 3, 271  
 Kane, William G. and Gierhart, Guy B., 3, 9,  
     15, 16, 271  
*Kelliellidae*, 98  
*Kellogii*, *Bulla*, 264  
*kellogii*, *Cylichna*, 264, 265  
*kellogii*, *Cylichna* (*Acrotrema*), 36, **264**  
*kellogii*, *Cylichnina*, 264  
 Kellum, Lewis, B., 3, 271  
*kennedyi*, *Sulcocypraea*, 179  
 Key Map, 2  
 Kincaid formation, 4, 5, 6  
 King, Philip B., 271  
*koureos*, *Galeodea*, 77, **180**  
*koureos*, *Galeodea* (*Mambrinia*), 180  
*Kuphus*, **140**  
*Kuphus incrassatus*, 19, 38, **140**
- labiata*, *Mya*, 137  
*Lacinia*, 202, **204**  
*Lacinia alveata*, 205  
     *santander*, 13, 36, **204**, 205, Pl. 21, figs. 2,  
     8, 9, 10  
*Lacunaria*, 170  
 Ladd, Harry S., v  
*laevigata*, *Xenophora*, 163  
*lalajensis*, *Plicatula*, **70**, 71  
*lamarckii*, *Rostellaria*, 168  
*lamarkii*, *Calyptrophorus*, 168  
*lamarkii*, *Potamides*, 162  
*Lamelliconcha*, **123**  
*Lamprodroma mississippiensis*, 216  
*lanceolata*, *Nucula*, 49  
*lapidosa*, *Lutraria*, 112, 113  
*lapidosa*, *Pteropsis*, **112**, 113  
*Lapparia*, 226  
*lapparoides*, *Volutocorbis*, 168  
*lapparoides*, *Volutospina*, 36, **225**, 226  
*laqueata*, *Corbula*, 130, 131  
*laqueata*, *Corbula* (*Varicorbula*), 38, **130**  
 Laredo formation, 5, 11-14, 15
- lower, 5, 12  
     middle, 5, 12, 13  
     upper, 5, 12, 14  
*Latirus*, 207, **211**, 213  
*Latirus aurantiacus*, 211  
     *moorei*, 13, 211, 212  
     *protractus*, 213  
     (*Cordiera*) *Moorei*, 211  
     (*Polygona*) *moorei*, 36, **211**, Pl. 24, fig. 10  
         sp., 36, **212**  
     (*Polygona*)? sp., **213**  
*Latirus? neoulios*, 213  
     (*Polygona*) *neoulios*, 36, **212**, Pl. 24, fig. 7  
*latus*, *Actaeon*, 259  
*leai*, *Monoptygma*, 195  
*Leda*, 43, 48  
*Leda acala*, 44, 45  
     *albirupina*, 46  
     *atakta*, 48  
     *bastropensis*, 46  
     *compsa*, 45  
     *concentrica*, 44  
     *eborea*, 43, 44  
     *elongatoidea*, 45  
     *lisbonensis*, 48  
     *magna*, 48  
         *lisbonensis*, 48  
     *mater*, 45, 46, 47  
     *opulenta compsa*, 45, 46  
     *pharcida*, 44  
     *plicata*, 46  
     *smirma*, 43, **44**, 48, Pl. 4, fig. 4  
     *sowerbyana*, 49  
     (*Adrana*) *aldrichiana*, 49  
     (*Ledina*) *smirna*, 44  
     (*Yoldia*) *eborea*, 44  
*Ledidae*, 43  
*Ledina*, **43**, 48  
*Ledina smirna*, 34, **44**, Pl. 4, fig. 4  
*Leidyi?*, *Pupa*, 267  
*Lembulus*, 48  
*Lemintina*, **154**  
*Lemintina cuvieri*, 154  
*Lemintina?* sp., **154**  
*Leptoconus*, **251**  
*Leptonacea*, 98  
*Leptosurcula*, **236**  
*Leptosurcula beadata*, 237  
     *beadata?*, 13, 36, **237**  
*Levifusus*, 230, 233  
*Levifusus trabeatoides*, 230, 231  
     *trabeatus*, 230, 231, Pl. 24, fig. 14  
*Lima*, 73  
*lima*, *Volutilithes*, 222



- Limopsis*, 51  
*Limopsis declivis*, 52  
*limopsis*, *Volutilithes*, 222, 223  
*limopsis*, *Volutilithes* (*Volutocorbis*), 222  
*limopsis*, *Volutocorbis*, 222, 223, 224  
*limula*, *Avicula*, 59  
*limula*, *Natica*, 172  
*limula*, *Neverita*, **172**, 173  
     *ceryx*, *Neverita*, 36, **172**, 173  
*limula*, *Pteria*, 37, **59**  
*lineata*, *Fusimitra*?, 220  
*lineata*, *Melania*, 154  
*lineolata*, *Melania*, 154  
*linifera*, *Tellina*, 107  
*linosa*, *Pseudoliva*, 198  
*linosa*, *Pseudoliva vetusta*, 198  
*linosa*, *Sulcobuccinum* (*Buccinorbis*), 198  
*lintea*, *Cypraea*, 179  
*lintea*, *Sconsia*, 181, 182  
*liodes*, *Oliva*, 216  
*Lirodiscus*, **89**, 90  
*Lirodiscus tellinoides*, 90  
*Lirodiscus*? n. sp., **90**  
*lisboa*, *Bolis*, 194  
Lisbon formation, 5, 11, 14  
*lisbonensis*, *Anomia*, 72, 73, 74  
*lisbonensis*, *Anomia ephippioides*, 72  
*lisbonensis*, *Calorhadia*, 45, 49  
*lisbonensis*, *Calorhadia* (*Litorhadia*), 48  
*lisbonensis*, *Leda*, 48  
*lisbonensis*, *Leda magna*, 48  
*lisbonensis*, *Ostrea*, 73, **79**, 128  
*lisbonensis*, *Ostrea sellaeformis*, 79  
*lisbonensis*, *Solen*, 111  
*lisbonensis*, *Solen* (*Plectosolen*), 111  
     *abruptus*, *Solen* (*Plectosolen*), 111  
*lisbonensis*, *Solena*, 111  
*lisbonensis*, *Solena* (*Eosolen*), **111**  
*lisbonensis*, *Volutocorbis*, 224  
     *crockettensis*, *Volutocorbis*, 223  
*lissoni*, *Aulacodiscus*, 166  
*lita*, *Cornulina* (*Revilla*), 36, **203**, 204  
*Lithodomus dactylus*, 57  
*Lithophaga*, **57**, 58, 269  
*Lithophaga clatbornensis*, 58  
     sp., **58**, Pl. 1, figs. 1, 5  
*lithophagus*, *Mytilus*, 57  
*Lithophysema*, **262**, 263  
*Lithophysema grande*, 263  
     *stewarti*, 37, **263**, Pl. 12, figs. 1, 4  
Litiopidae, 162  
*Litorhadia*, **44**, 45  
*Litorhadia santa-anai*, 45  
*Littorina antiquata*, 149  
*longiforma*, *Pleurotoma*, 233  
*longipera*, *Orthosurcula*, 233, 234  
     *tobar*, *Orthosurcula*, 233  
*longipera*, *Pleurotoma*, 233  
*longirostropsis*, *Pleurotoma* (*Pleurofusua*), **244**  
*Longiverena*, **154**, 155  
Lonsdale, John T. and Day, James R., 10, 271  
*Loripes subvexa*, 95  
*Loripes?* *turgida*, 98  
Los Guerras, 15  
Louisiana, 11  
Lower and middle Oligocene, 17, 18  
*Lucina*, 94  
*Lucina jamaicensis*, 95  
     *ornata*, 96  
     *subvexa*, 94, 95  
     *tenuisculpta*, 96  
     (*Divaricella*) *angulifera*, 96  
     (*Loripes*) *subvexa*, 95  
Lucinacea, 94  
Lucinidae, 94  
*ludoviciana*, *Arca* (*cuculloidis*?), 53  
*ludoviciana*, *Arca* (*Barbatia*) *cuculloidis*, 53  
*ludoviciana*, *Barbatia*, 53  
*ludoviciana*, *Crassatellites clarkensis*, 92  
*ludovicianus*, *Falsifusus*, 207  
*lupina*, *Venus*, 97  
*Lutetia*, **98**, 99  
*Lutetia parisensis*, 99  
     *parisiensis*, 98  
     *texana*, 11, 36, **99**, 126  
     *umbonata*, 99  
*Lutraria*, 113  
*Lutraria lapidosa*, 112, 113  
     *papyria*, 112  
*lyelli*, *Chlamys*, 65  
*Lyropecten*, **67**, 68, 69  
*Lyropecten estrellanus*, 67  
     *sayanus*, 68  
*Lysinoe*, 18, 177, 267  
  
*macdonaldi*, *Pecten*, 64  
*macdonaldi*, *Pecten* (*Pecten*), 64  
*Macrocallista*, **114**, 115  
*Macrocallista sobrina*, 115  
     (*Chionella*) *cantui*, 38, **115**, Pl. 10, figs.  
         7-9, 11, ?13, ?14  
     *sobrina*, 115  
     (*Chionella*?) sp., **115**  
*Macrochlamys*, 67  
*Mactra cygnea*, 90  
     *donacia*, 113  
Mactracea, 112  
Mactridae, 112



- mactriiformis*, *Corbula*, 137  
 Mactrinae, 112  
*mactroides*, *Erodona*, 137, 138  
*magna*, *Leda*, 48  
     *lisbonensis*, *Leda*, 48  
*magnifica*, *Nucula*, 41, 42  
     *mauricensis*, *Nucula*, 41  
*magnum*, *Cardium*, 101  
*malinchae*, *Anomia*, 72, Pl. 5, figs. 1, 2  
*Mambrinia*, 180, 181  
*mammilla*, *Nerita*, 173  
*mammillaris*, *Natica*, 173  
 Manados Creek, 12  
*Mangilia*, 247  
 Map of northeastern Mexico showing fossil localities, Pl. 28  
*Margaritella*, 170  
*margaritosa*, *Coronia*, 240, 241  
*margaritosa*, *Gemmula*, 240  
*marginatus*, *Solen*, 111  
 Marianna limestone, 5  
*marmoreus*, *Conus*, 250  
*marshi*, *Tibiella*, 266  
 "Martesia" *rotunda*, 139  
*mater*, *Calorhadia*, 47  
*mater*, *Calorhadia* (*Litorhadia*), 37, 47  
*mater*, *Leda*, 45, 46, 47  
*Mathilda*, 149  
 Matthews Landing, 7  
*matutina*, *Chione*, 125, 126  
*matutina*, *Chione* (*Chamelea*?), 38, 125  
*mauricensis*, *Nucula*, 41, 42, 120  
*mauricensis*, *Nucula magnifica*, 41  
*mauricensis*, *Ostrea*, 84  
 Maverick County, 6, 8, 9  
*maxima*, *Ostrea*, 61  
*Mazza wilsoni*, 210  
*Mazzalina*, 213, 214  
*Mazzalina dalli*, 214  
     *inaurata*, 213  
     *pyrula*, 213  
     sp., 213  
     sp. cf. *M. inaurata*, 16  
*Mazzalina? heilpriniana*, 214  
     *pyrobola*, 36, 214, Pl. 21, figs. 3-7  
 McElroy, 16  
 McElroy member, 5  
*media*, *Calorhadia*, 47  
*mediavia*, *Nucula*, 41  
*mediaviense*, *Dentalium*, 141  
*meekana*, *Architectonica*, 153  
*Megatylotus*, 174  
*Melanatria*, 156  
*Melania lineata*, 154  
     *lineolata*, 154  
     *tuberculata*, 154  
 Melaniidae, 154  
 Melanopsidae, 156  
*melanura*, *Alaba*, 162  
*melanura*, *Rissoa*, 162  
*melinoides*, *Acteocina*, 37, 261  
*mellingtoni*, *Mitra*, 220  
*Mellingtoni*, *Mitra* (*Fusimitra*), 220, 221  
*Melo pyruloides*, 229  
*Melongena*, 200, 201, 202, 204  
*Melongena alveata*, 204  
     *armigera*, 202  
     *crassi-cornuta*, 201, 202  
     sp., 201, Pl. 19, fig. 5  
*Melongena? potomacensis*, 201  
*melongena*, *Murex*, 200  
*melongena*, *Pyrula*, 200  
 Melongeninae, 200, 204  
 Mendez, 19  
*mendezense*, *Cerithium*, 38, 160  
*mendezensis*, *Oliva*, 38, 217  
*mendezensis*, *Pitar* (*Hysteroconcha*), 38 123  
*meneghinii*, *Pleurotoma*, 243  
*Meretrix nuttali*, 116  
     *securiformis*, 120  
     *texacola*, 117, 118  
     *tornadonis*, 117  
     *trigoniata*, 116  
         *bastropensis*, 116, 117  
*Mesalia claibornensis*, 36  
     *sayi*, 34  
*Mesodesma*, 113  
*Mesodesma singleyi*, 37, 114, Pl. 7, fig. 6  
 Mesodesmatidae, 113  
*Metis*, 107  
*Metis trinitaria*, 108  
*mexicana*, *Bolis*, 36, 194  
*mexicanus*, *Hemisinus siliceus*, 38, 155  
*meyeri*, *Falsifusus*, 207  
*meyeri*, *Fusus*, 206, 207  
*meyeri*, *Tellina*, 107  
*Michela*, 230  
*Michela trabeatoides*, 13, 14, 36, 231, Pl. 24, fig. 13  
*Microdrillia*, 247  
*Microdrillia aldrichiella*, 247, 248  
     *harrisi*, 36, 247, 248  
     *harrisi?*, 14  
*microgrammata*, *Anomia*, 74  
 Midway formation, 4, 5  
     lower, 4, 5, 6  
     upper, 5, 7, 8  
 Midway group, 4, 5



- Mier district, 9, 10, 11, 12  
 Mier oyster beds, 14, 15  
*migum*, *Buccinum*, 193  
*millegranum*, *Solarium*, 152  
*millingtoni*, *Mitra*, 220, 221, 222  
*Millingtoni*, *Mitra* [*Mellingtoni*], 221  
*millingtoni*, *Mitra* (*Cancilla*), 221  
*millingtoni*, *Mitra* (*Fusimitra*), 37, **221**  
*Miltha*, 96  
*minax*, *Cornulina armigera*, 202  
     *heilpriniana*, *Cornulina*, 214  
*minax*, *Fusus*, 201  
*minax*, *Murex*, 201  
*minima*, *Fusimitra*?, 220  
*minutistriatum*, *Dentalium*, 141  
 Miocene, lower, 5, 19  
     middle, 5, 21  
 Miocene series, 5, 19  
 Miocene, upper, 5  
*miralejas*, *Hemisinus*, 38, **155**  
*mirula*, *Terebra*, 256, 257  
*mirula*, *Terebra* (*Terebrella*), 256  
*mississippiense*, *Buccinum*, 190  
*mississippiense*, *Dentalium* (*Antalis*), 37, 38, **142**  
*mississippiense*, *Sinum*, 38, **178**  
*mississippiensis*, *Ampullina*, 38, **175**, 176  
*mississippiensis*, *Ampullina crassatina*, 175  
*mississippiensis*, *Arca*, 53  
*mississippiensis*, *Brachidontes*, 38, **56**  
*mississippiensis*, *Catinus*, 178  
*mississippiensis*, *Chione*, 125, 126  
*mississippiensis*, *Chione* (*Chamelea*), **125**  
*mississippiensis*, *Cytherea*, 125  
*mississippiensis*, *Dentalium*, 142  
*mississippiensis*, *Ficus*, 38, **184**  
*mississippiensis*, *Glycymeris*, 51  
*mississippiensis*, *Lamprodroma*, 216  
*mississippiensis*, *Modiola*, 56  
*mississippiensis*, *Modiolus* (*Brachydontes*), 56  
*mississippiensis*, *Murex*, 187  
*mississippiensis*, *Murex* (*Murex*), 38, **187**  
*mississippiensis*, *Natica*, 174, 175  
*mississippiensis*, *Oliva*, **216**, 217  
     *santander*, *Oliva*, 18, 38, **217**  
*mississippiensis*, *Olivella*, 216  
*mississippiensis*, *Pectunculus*, 51  
*mississippiensis*, *Pyrula*, 184  
*mississippiensis*, *Sigaretus*, 178  
*mississippiensis*, *Sigaretus bilix*, 178  
*mississippiensis*, *Venus*, 125  
*Mitra*, **220**  
     *cellulifera*, 220  
         *conquisita*, 220, 221, 222  
         *mellingtoni*, 220  
         [*Mellingtoni*] *Millingtoni*, 221  
         *millingtoni*, 220, 221, 222  
         *mississippiensis*, 220, 222  
         *polita neta*, 13  
         *tesselata*, 220  
         (*Cancilla*) *millingtoni*, 221  
         (*Fusimitra*) *conquisita*, 38, **222**  
             *Mellingtoni*, 220, 221  
             *millingtoni*, 37, **221**, Pl. 14, fig. 5  
             *polita*, **220**, 221  
             *polita neta*, 36, **221**, Pl. 24, figs. 1, 6  
             (*Tiara*), 236  
*Mitrella*, **189**  
*Mitrella flaminea*, 189  
     *garzai*, 36, **189**, Pl. 14, fig. 6  
     sp., 190  
 Mitridae, 210, 220  
*Modiola alabamensis*, 57  
     *mississippiensis*, 56  
     *sulcata*, 56  
*Modiolaria*, 56  
*Modiolaria alabamensis*, 57  
     *alabamensis*, 57  
*Modiolus*, 56, 57, 58  
*Modiolus* (*Brachydontes*) *mississippiensis*, 56  
 Mollusca, 40  
*Monoceros armigerus*, 201, 202  
     *velusta*, 196  
     *velustus*, 196  
*Monoptygma leai*, 195, Pl. 27, figs. 2, 5  
 Moodys Branch marl, 5  
*mooreana*, *Tellina*, **106**  
*mooreana*, *Tellina papyria*, 106  
*Moorei*, *Cordieria*, 211  
*moorei*, *Eosurcula*, 36, **235**, 236  
     *moorella*, *Eosurcula*, 236  
*moorei*, *Fasciolaria*, 211  
*moorei*, *Latirus*, 211, 212  
     (*Cordiera*), 211  
     (*Polygona*), 36, **211**  
*moorei*, *Pleurotoma* (*Surcula*), 235  
*moorei*, *Surcula*, 235  
*moorei*, *Turris*, 235  
*moorella*, *Eosurcula moorei*, 236  
*mortoni*, *Fusus*, 208, 209  
     *carexus*, *Fusus*, 208  
     *mortoniopsis*, *Fusus*, 208, 209  
*mortoniopsis*, *Falsifusus*, 36, 197, **208**, 209  
*mortoniopsis*, *Fusus*, 208, 209  
*mortoniopsis*, *Fusus mortoni*, 208, 209  
 Mt. Selman formation, 5, 10, 11  
 Muir, John M., 3, 271  
*multicarinata*, *Cypraedia*, 179  
*multicarinata*, "Ovula", 179



- mullicarinata*, *Ovula* (*Transovula*), 179  
*mullicostata*, *Eopleurotoma*, 237  
*murchisoni*, *Corbula*, 132  
*Murex*, **187**, 188  
*Murex aruanus*, 205  
     *canaliculatus*, 206  
     *carica*, 205  
     *cataphractus*, 248  
     *ficus*, 183  
     *filosus*, 211  
     *gibbulus*, 211  
     *infundibulum*, 211  
     *melongena*, 200  
     *minax*, 201  
     *mississippiensis*, 187  
     *pecten*, 187  
     *scriptus*, 189  
     sp., **188**  
     *tribulus*, 187  
     *tubifer*, 188  
     *tulipa*, 215  
     (*Argobuccinum*?) sp., **188**  
     (*Murex*) *chipolanus*, 188  
         *mississippiensis*, 38, **187**, Pl. 19, fig. 6  
 Muricacea, 187  
*muricatum*, *Busycon*, 205  
 Muricidae, 187  
*Musculus*, **56**, 57  
*Musculus alabamensis*, 57  
     *carlotae*, 34, **57**, Pl. 5, figs. 3, 6  
     *discors*, 57  
     sp., **57**  
*Mya erodina* (error for *erodona*), 137  
     *glycimeris*, 138  
     *labiata*, 137  
     *purpurea*, 127  
 Myacea, 126  
 Mytilacea, 56  
 Mytilidae, 56  
*Mytilus discors*, 57  
     *hirundo*, 58  
     *lithophagus*, 57  
 Naheola formation, 5, 7  
*nana*, *Pseudoliva*, **195**  
 Nanafalia formation, 5, 7, 8  
*Nassa cancellata*, 191  
 Nassariidae, 190  
*nasuta*, *Corbula*, 133  
 "Natella", 172  
*Natica*, **171**, 173, 174  
*Natica amphora*, 176  
     *aperta*, 170, Pl. 14, fig. 9  
     *brunnea*, 173  
     *crassatina*, 175  
     *dumblei*, 174  
     *eminula*, 174  
     *infundibulum*, 170  
     *limula*, 172  
     *mammillaris*, 173  
     *mississippiensis*, 174, 175  
     *permunda*, 172  
     *perspecta*, 34, **171**, Pl. 14, fig. 11  
     *recurva*, 177  
     (*Girodes*) *alabamiensis*, 170  
     (*Gyrodes*) *aperta*, 170, Pl. 14, fig. 9  
         *crenata*, 170  
 "Natica" sp., **171**  
 Naticacea, 169  
 Naticidae, 169  
*naucum*, *Bulla*, 262  
 Nautiloidea, 268  
*Nautilus orbiculatus*, 268  
     *ulrichi*, 268  
*navalis*, *Teredo*, 139  
*navicelloides*, *Anomia*, 73  
     *hammetti*, *Anomia*, 73  
*Neaera gouldiana*, 88  
*negreetensis*, *Crassatellites*, 91  
*Nemocardium*, **104**  
*Nemocardium diversum*, 38, **105**  
     *nicolletti*, 104  
     sp., **104**  
*neotera*, *Chlamys nicholsi*, 68  
*neotera*, *Chlamys* (*Lyropecten*?) *nicholsi*, 68  
*neoullos*, *Latirus*?, 213  
*neoullos*, *Latirus*? (*Polygona*), 36, **212**  
*Neptunea*, 194  
*Nerita*, **144**, 145  
*Nerita mammilla*, 173  
     *peloronta*, 144  
     sp., **145**  
     *tampaensis*, 19, 38, **145**  
     *vitellus*, 171  
 Neritacea, 144  
 Neritidae, 144  
*Neritina*, 145  
*neta*, *Mitra* (*Fusimitra*) *polita*, 36, **221**  
*Neverita*, **172**  
*Neverita josephinia*, 172  
     *limula*, **172**, 173  
         *ceryx*, 13, 36, **172**, 173, Pl. 14, figs. 10, 12  
     *onusta*, 173, Pl. 14, fig. 14  
         (*Glossaulax*), 172  
*newtonensis*, *Cadulus*, 143  
*nicholsi*, *Chlamys*, 68



- nicholsi*, *Chlamys* (*Plagioctenium*), 68  
*neotera*, *Chlamys*, 68  
(Lyropecten?), 68  
*nicolletti*, *Nemocardium*, 104  
*nigra*, *Pinna*, 60  
*nimbosa*, *Corbula*, 138  
*nimbosa*, *Venus*, 114  
*Noae*, *Fusus*, 209  
*nobilis*, *Architectonica*, 151  
*nodifera*, *Surcula*, 231  
*Nodipecten*, **68**  
*Nodipecten dumblei*, 69  
*Nodipecten fauna*, 20  
*nodocarinata*, *Drillia*, 238  
*nodocarinata*, *Eopleurotoma*, 238  
*nodocarinata*, *Hesperiturris*, **237**, 238  
*nodo-carinata*, *Pleurotoma*, 238  
*nodocarinata*, *Pleurotoma* (*Drillia*), 238  
*nodocarinata*, *Surcula*, 238  
*nodocarinata*, *Turris*, 237, 239  
*nodosa*, *Ostrea*, 68  
*nodulosum*, *Cerithium*, 160  
*Noetia pulchra*, 51  
Noetinae, 51  
*Nonionella cockfieldensis* zone, 197  
Nonmarine bed, 18  
*normalis*, *Ostrea*, 84, 85  
*normalis*, *Ostrea georgiana*, 84  
*Nucleopsis*, **259**, 260  
*Nucleopsis* sp., 37, **260**, Pl. 16, figs. 9, 10  
*nucleus*, *Arca*, 40  
*nucleus*, *Corbula*, 127  
*Nucula*, **40**, 41  
*Nucula commutata*, 48  
*concava*, 43  
*eborea*, 43, 44  
*Nucula gaultina*, 41  
*lanceolata*, 49  
*magnifica*, 41, 42  
*mauricensis*, 41  
*mauricensis*, 36, **41**, 42, 120  
*mediavia*, 41  
*ovula*, 42  
sp., **42**  
sp. A., **42**  
sp. B., **43**  
sp. aff. *N. mediavia*, **41**  
*spheniopsis*, 37, **42**, Pl. 1, fig. 3  
*vicksburgensis*, 42  
Nuculacea, 40  
*Nuculana*, **43**, 45  
Nuculanidae, 43  
Nuculidae, 40  
*nuda*, *Celliforma*, 269  
Nuevo León, 3, 7  
Nuevo Santander, 1  
*nupera*, *Chlamys*, 65, 66  
*nuperum*, *Pecten*, 66  
*nuperus*, "Cassis", 181  
*nuperus*, *Chlamys* (*Chlamys*), 66  
*nuperus*, *Pecten*, 66  
*nuperus*, *Pecten* (*Chlamys*), 66  
*Nuttali*, *Cytherea*, 116  
*nuttali*, *Meretrix*, 116  
*Nuttallii*, *Cytherea*, 116  
Oak Grove sand member, 5  
Oakville sandstone, 5, 21  
*obliquus*, *Solen*, 111  
*oblongata*, *Panopaea*, 138  
*oblongata*, *Panope*, 37, 38, **138**  
*oblongata*, *Panopea*, 138  
Ocala limestone, 5  
*Ochetoclava*, **160**, 161  
*Ochetoclava* sp., 21  
*Odostomia bidentata*, 146  
Oligocene, lower, 5  
lower marine sandstone, 5  
middle, 5  
nonmarine clay, 5  
series, 5, 17  
upper, 5  
upper limestone, 5  
upper marine sandstone, 5  
*Oligotoma*, 243  
*Oliva*, **216**, 218  
*Oliva corticata*, 216  
*liodes*, 216  
*mendezensis*, 38, **217**, Pl. 27, fig. 8  
*mississippiensis*, **216**, 217  
*santander*, 18, 38, **217**, Pl. 27, fig. 12  
*reticularis*, 216  
*santander*, 217  
*sayana*, 216  
sp. cf. *O. liodes*, 39, **216**  
*Olivella*, **217**, 218  
*Olivella blastoides*, 38, **218**, Pl. 16, fig. 14  
*dama*, 217  
*mississippiensis*, 216  
*purpurata*, 217  
sp., **218**  
Olividae, 216  
*Olivula*, **219**  
*Olivula punctulifera*, 13, 36, **219**, Pl. 27, figs. 19, 20  
sp., 35, **219**  
*olssoni*, *Volutocorbis*, 223  
*oniscus*, *Corbula*, 132



- onusta*, *Neverita*, 173, Pl. 14, fig. 14  
*opercularis*, *Ostrea*, 67  
*Operculina*, 17  
*Opisthobranchia*, 258  
*opulenta compsa*, *Leda*, 45, 46  
*orbicularis*, *Glycymeris*, 50  
*orbiculatus*, *Nautilus*, 268  
*ornata*, *Lucina*, 96  
*Orthaulax*, **168**, 169  
*Orthaulax inornatus*, 169  
     *pugnax*, 19, 38, **169**, Pl. 19, figs. 3, 4  
     sp., **169**  
*Orthosurcula*, **233**  
*Orthosurcula longipera*, 233, 234  
     *tobar*, 233  
     *longipera?*, 35, **233**  
     *pagodiformis*, 233, 234, Pl. 14, fig. 4  
*Orthosurcula? adeona*, 233, 234, Pl. 25, fig. 8  
     *langdoni*, 233, Pl. 25, figs. 17, 22  
*Orthoyoldia*, **49**, 50  
*Orthoyoldia psammotaea*, 36, **50**, Pl. 4, figs. 2, 3  
     *scapania*, 50  
     *solenoides*, 50  
*ostrarupis*, *Pseudoliva*, 195  
     *pauper*, *Pseudoliva*, 195  
*Ostrea*, **75**  
*Ostrea alabamiensis*, 81, 82  
     *contracta*, 81  
     *georgiana*, 81  
     *cahobasensis*, 21, 84, 85  
     *compressirostra*, 84  
     *contracta*, **81**, 82  
         *amichel*, 36, 80, **81**, 82, Pl. 3, figs. 1, 2  
     *edulis*, 75  
     *eothisae*, 6, 7, 34, **75**, 77, Pl. 5, figs. 10, 11  
     *falco*, 77  
     *frionis*, 82  
     *frithi*, **82**, 83, Pl. 2, figs. 7, 9  
*Ostrea georgiana*, 81, 84  
     *normalis*, 84  
     *gierharti*, 10, 11, 36, **78**, 79, Pl. 2, figs. 1-4  
     *hailensis*, 82  
     *intermedoides*, 9, 77, 78  
     *lisbonensis*, 36, 73, **79**, 128, Pl. 1, figs. 20-22  
     *lisbonensis zone*, 11, 13, 14, 48, 57, 65, 128, 195  
     *mauricensis*, 84  
     *maxima*, 61  
     *nodosa*, 68  
     *normalis*, 21, 84, 85  
     *opercularis*, 67  
     *pleuronectes*, 69  
     *pulaskensis*, 76  
     *radians*, 80  
     *sellaeformis*, 13, 14, 36, 76, 79, **80**, 82, 135  
         *lisbonensis*, 79  
     *sellaeformis zone*, 13, 14, 207, 244  
     *semmesi*, **78**, 79, Pl. 2, figs. 6, 8  
     *smithvillensis*, 79  
*Ostrea* sp., **82**, **83**, **85**, Pl. 2, fig. 5; pl. 4, fig. 5  
     sp. cf. *O. cahobasensis*, 39, **84**  
         *intermedoides*, 34, **77**  
         *normalis*, **84**  
     *thirsae*, 7, 8, 34, 75, **76**, 77, 79, Pl. 5, figs. 15-19  
     *trigonalis*, 82, **83**  
     *vaughani insularis*, 84, 85  
     *vicksburgensis*, 18, 39, **83**, 84  
     *virginica*, 84  
     *vomer*, 76  
     *ziczac*, 62  
*Ostreacea*, 75  
*Ostreidae*, 75  
*ottonis*, *Fusus*, 206  
*ovalina*, *Cytherea*, 115  
*"Ovula" multicarinata*, 179  
*Ovula (Transovula) multicarinata*, 179  
*ovula*, *Nucula*, 42  
*ovulum*, *Dentalium*, 142  
*oxygonum*, *Pecten*, 67  
  
*pagodiformis*, *Orthosurcula*, 233, 234  
*Paleocene series*, 4, 5  
*palliata*, *Rostellaria*, 166  
*panones*, *Cancellaria*, 230  
*Panopaea oblongata*, 138  
*Panope*, **138**  
*Panope aldrovandi*, 138  
     *oblongata*, 37, 38, **138**  
*Panopea oblongata*, 138  
*papyracea*, *Venus*, 121  
*papyraceum*, *Amusium*, 69  
*papyratia*, *Ficus*, 184  
*papyria*, *Lutraria*, 112  
*papyria*, *Tellina*, 106  
     *mooreana*, *Tellina*, 106  
*Paradione*, 114  
*parisensis*, *Lutetia*, 99  
*parisiense*, *Cerithium*, 156  
*parisiensis*, *Lutetia*, 98  
*parsaba*, *Arca rhomboidella*, 55  
*Parvamussium*, **70**  
*Parvilucina*, **96**  
*Patella chinensis*, 163  
*patula*, *Ancillopsis*, 199  
*pauper*, *Pseudoliva ostrarupis*, 195  
*Pecten*, **61**, 67, 69, 70  
*Pecten anatipes*, 62



- burlesonensis*, 64  
*burlesonensis* (*clarkeanus*? var), 64  
*byramensis*, 18, 19, 62, 63  
*clarkeanus*, 64, 65  
*condylomatus*, 69  
*deshayesii*, 64  
*duodecim-lamellatus*, 70  
*islandicus*, 64  
*macdonaldi*, 64  
*nuperum*, 66  
*nuperus*, 66  
*oxygonum*, 67  
*perplanus*, 62  
*plurinominis*, 67  
*poulsoni*, 62, 63  
*raveneli*, 62  
*thetidis*, 67  
(*Aequipecten*) *perplanus*, 62  
*thetidis*, 67  
(*Chlamys*) *clarkeanus*, 64  
*nuperus*, 66  
(*Euvola*), 63  
(*Nodipecten*) *condylomatus*, 20, 69  
(*Pecten*), **61**, 62, 63, 64  
(*Pecten*) *byramensis*, 38, **62**, 63, Pl. 10, figs. ?1, ?2, ?3, ?4  
*macdonaldi*, 64  
*poulsoni*, 62, 63  
sp. cf. *P. (P.) macdonaldi*, 39, **64**, Pl. 11, figs. 1, 3  
sp. cf. *P. (P.) poulsoni*, 38, **62**  
(*Propeamussium*) *ceciliae*, 70  
Pectinacea, 61  
*pectinata*, *Tellina*, 95  
Pectinibranchiata, 145  
Pectinidae, 61  
*Pectunculus declivis*, 52  
*mississippiensis*, 51  
Pelecypoda, 40  
*peloronta*, *Nerita*, 144  
*penita*, *Pyrula*, 183  
Penrose, R. A. F., 3  
*Penrosei*, *Clavella* (*Fusus*?), 209  
*penrosei*, *Clavilithes*, 36, **209**  
*penrosei*, *Surculoma*, 212, 242, 243  
*perdubia*, *Corbula* (*Aloidis*), 130  
*perdubia*, *Corbula* (*Neaera*), 130  
*perexilis*, *Fusimitra*?, 220  
*Perissolax*, 170, **183**  
*Perissolax diga*, 35, **183**  
*eocensis*, 183  
*trivolvus*, 183  
*permunda*, *Natica*, 172  
*pernula*, *Arca*, 43  
*perplanus*, *Pecten*, 62  
*perplanus*, *Pecten* (*Aequipecten*), 62  
*persa*, *Pleurotoma*, 233  
*Personella*, **184**  
*Personella sep [lem] dentata*, 185  
*septemdentata*, 13, 36, **185**, Pl. 17, figs. 12, 13  
*perspecta*, *Natica*, **171**  
*perspectiva*, *Pseudoliva*, 197, 198  
*perspectiva*, *Pseudoliva vetusta*, 197  
*perspectivus*, *Trochus*, 150  
*peruvianus*, *Xancus*, 211  
*petersoni*, *Galeodea* (*Galeodaria*), 180  
*petrosa*, *Athleta*, 225  
*tuomeyi*, *Athleta*, 228  
*petrosa*, *Volutilithes*, 222  
*tuomeyi*, *Volutilithes*, 228  
*petrosa*, *Volutospina*, 224, 225, 226  
*Phacoides*, **95**, 96  
*Phacoides quintamaia*, 36, **95**, 96, Pl. 7, fig. 14  
*Phacoides*? sp., **96**  
*Phacoides* (*Parvilucina*), 120  
*Phacoides* (*Parvilucina*) *smithi*, 96  
sp., **96**  
*pharcida*, *Calorhadia*, 45  
*pharcida*, *Leda*, 44  
Pholad, 34, **139**, Pl. 8, fig. 11  
Pholadidae, 138  
*Pholadomya*, **85**, 86  
*Pholadomya candida*, 85  
*claibornensis*, 86  
*harrisi*, 36, **86**, Pl. 6, figs. 1-3, 8, 9, 12  
Pholadomyidae, 85  
*Phos*, 186  
*Phos hilli jacksonensis*, 193  
*texana*, 192  
*texanus*, 191, 192  
*picta*, *Ficus*, 183  
*picta*, *Pleurotoma*, 246  
*Pineda*, **214**, 215  
*pinguis*, *Gegania*, 149  
*Pinna*, 60  
*Pinna gravida*, 60  
*nigra*, 60  
*vexillum*, 60  
Pinnidae, 60  
*Pirula*, 183  
*piruloides* [*pyruloides*], *Turbinella*, 228  
*Pitar*, **122**, 123  
*Pitar* (*Hysteroconcha*) *mendezensis*, 38, **123**, Pl. 11, Figs. 5, 8  
*Pitaria harrisi*, 124  
*plagiaulax*, *Solen*, 111  
*plagiaulax*, *Solena*, 111  
*plana*, *Rimella texana*, 166



- planicosta*, *Venericardia* (*Venericor*), 93  
*planotecta*, *Cassidaria*, 180, 181  
*planotecta*, *Galeodea*, 36, **181**  
*planotecta*, *Galeodea* (*Mambrinia*), 181  
*platysoma*, *Pleurotoma*, 234, 235  
*Plejona tuomeyi*, 228  
*plenta*, *Borsonia*, 197, 234  
*Plentaria*, 234  
*Plentaria*, *plenta*, 234, Pl. 25, figs. 3, 5  
*Pleurofusua*, **244**  
*Pleurofusua*, *collaris*, 37, **244**, 245  
     *servata*, 245  
     *vicksburgensis*, 38, **245**  
*Pleuroliria*, **245**, 246  
*Pleuroliria cochlearis*, 246  
     *sp.*, 246  
     *tenagos*, 39, **246**  
*pleuronectes*, *Ostrea*, 69  
*Pleurotoma*, 240, 247, 249, 250  
*Pleurotoma acutirostra*, 240  
     *albicarinata*, 246  
     *albida tellea*, 246  
     *beadata*, 236, 237  
     *childreni*, 240  
     *cochlearis*, 245, 246  
     *coelata*, 242  
     *collaris*, 244  
     *cossmanni*, 247  
     *gabbi*, 233  
     *gabbii*, 234  
     *huppertzi*, 242  
     *infans*, 247, 248  
     *langdoni*, 233, Pl. 25, figs. 17, 22  
     *longiforma*, 233  
     *longipera*, 233  
     *meneghinii*, 243  
     *nodo-carinata*, 238  
     *persa*, 233  
     *picta*, 246  
     *platysoma*, 234, 235  
     *roscoei*, 247  
     *servatoidea*, 243, Pl. 25, figs. 18, 21  
     *silicata*, 246, 247, Pl. 25, figs. 19, 20  
     *subaequalis*, 242  
     *tabulata*, 242  
     *terebriformis*, 243  
     *texana*, 244  
     *tuomeyi*, 235  
     *vicksburgensis*, 245  
     (*Drillia*) *nodocarinata*, 238  
     (*Pleurofusua*) *longirostropsis*, 244  
     (*Pleuroliria*) *supramirifica*, 245  
     (*Surcula*) *gabbi*, 234  
         *gabbii*, 234  
         *moorei*, 235  
     *plicata*, *Fasciolaria*, 212  
     *plicata*, *Leda*, 46  
     *Plicatula*, **70**  
     *Plicatula euplecta*, 13, 36, **71**, Pl. 1, figs. 13, 14  
         *filamentosa*, 71  
         *lalajensis*, 34, **70**, 71, Pl. 5, fig. 4  
     *plicatula*, *Terebra*, 258  
     *plicatus*, *Spondylus*, 70  
     *plicifera*, "Clava", 162  
     *plicifera*, *Potamides?*, **162**  
     *plicifera*, *Terebra*, 162, 214  
     *plumbea*, *Pseudoliva*, 195  
     *plumbeum*, *Buccinum*, 194  
     Plummer, F. B., 271  
     *plurinominis*, *Chlamys* (*Aequipecten*), 67  
     *plurinominis*, *Pecten*, 67  
     *Polinices*, 171, **173**  
     *Polinices albus*, 173  
         *harrisii*, 174, Pl. 14, fig. 13  
     *Polinices? alamedensis*, 34, **173**, 174, Pl. 15, figs. 5, 6, 9, 10  
     *polita*, *Conomitra* (*Turricula*), 220  
     *polita*, *Fasciolaria*, 220  
     *polita*, *Fusimitra*, 220  
     *polita*, *Mitra* (*Fusimitra*), **220**, 221  
         *neta*, *Mitra* (*Fusimitra*), 36, **221**  
     *politum*, *Teinostoma*, 144  
     *Polygona*, **211**  
     *Polygona fusiformis*, 211  
     *polygyra*, *Terebra*, 257  
     *Polymetis*, 107  
     *Polyschides*, **143**  
     *Polystira*, 246  
     *Polystira* (*Pleuroliria*) *tenagos*, 246  
     *polythalamia*, *Teredo*, 140  
     *polythalamia*, *Teredo* (*Kuphus*) *aff.*, 140  
     *popenoe*, *Calyptrophorus*, **166**, 167  
     Poromyacea, 88  
     Porters Creek formation, 5  
     *Portunus* (*Portunus*) *haitensis*, 21  
     *Potamides*, 160, **162**  
     *Potamides hillsboroensis*, 159  
         *lamarkii*, 162  
     *Potamides? plicifera*, 36, **162**, Pl. 18, figs. 5, 6  
     *Potamomya*, 137  
     *potomacensis*, *Melongena?*, 201  
     *poulsoni*, *Callocardia*, 118  
     *poulsoni*, *Pecten*, 62, 63  
     *poulsoni*, *Pecten* (*Pecten*), 62, 63  
     *praecisa*, *Venericardia*, 94  
     *precursor*, *Volutilithes*, 223  
     Prieto, Alejandro, 1, 271  
     *prima*, *Cuspidaria*, 88, 89  
     Prionodesmacea, 40  
     *Priscoficus*, **182**



- Priscoficus juvenis*, 182  
     *tritiaria*, 182  
     (*Fulguroficus*) *juvenis*, 35, **182**  
         sp., 35, **182**  
         *tritiaria*, 35, **182**  
*priscopsis*, *Corbula* (*Potamomya*), 137  
*Propeamusium*, 70  
*Propeamussium*, 70  
*prosayana*, *Callocardia*, 119  
*protecta*, *Terebra*, 256  
*protextus*, *Crassatellites*, 91, 92  
*Protocardia*, 104  
*Protocardia diversa*, 105  
     *gambrina*, 105  
*Protosurcula*, **234**, 235  
*Protosurcula gabbi*, 234  
     *gabbii*, 36, **234**, 235, Pl. 25, figs. 14, 15  
     *tenuirostris*, 234  
*protracta*, *Rimella*, 165  
*protractus*, *Conus*, 254  
*protractus*, *Conus* (*Leptoconus*?), 38, **254**  
*protractus*, *Latirus*, 213  
*Psammobia*, 108  
*Psammobia eborea*, 109  
*psammotaea*, *Orthoyoldia*, **50**  
*psammotaea*, *Yoldia*, 50  
*Pseudamussium*, 69, 70  
*Pseudamussium alabamense*, 70  
*Pseudoliva*, **194**, 195, 199, 200, 201, 202, 204, 214  
*Pseudoliva carinata*, 13, 36, **197**, 198, Pl. 22, figs.  
     ?15, ?16, ?17, ?18  
     *elliptica*, 195, Pl. 27, figs. 3, 4  
     *fusiformis*, 197, Pl. 24, figs. 11, 12  
     *linosa*, 198  
     *nana*, 6, 35, **195**, Pl. 12, figs. 5-8  
     *ostrarupis*, 195  
         *pauper*, 195  
     *perspectiva*, 197, 198  
     *plumbea*, 195  
     *santander*, 13, 36, **195**, 196, 197, Pl. 22, fig.  
         24  
     sp., **198**  
     sp. cf. *P. linosa*, **198**, Pl. 22, fig. 19  
     *vetusta*, 36, 37, 195, **196**, Pl. 16, figs. 17, 19  
         *linosa*, 198  
         *perspectiva*, 197  
     (*Buccinorbis*) *carinata*, 197  
         *vetusta*, 196  
     (*Monoceros*) *armigera*, 202  
*Pseudolivinae*, 194  
*Pseudoperissolax*, 183  
*Pseudophragmina zaragoensis*, 8  
 "Pseudotaphrus" *varicifer*, 162  
*pteleina*, *Callocardia*, 116  
*Ptenoglossa*, 146, 149  
*Pteria*, **58**, 59  
*Pteria argentea*, 59  
     *deussenii*, 59  
     *limula*, 36, 37, **59**, Pl. 1, fig. ?12  
     sp., 38, **59**  
     sp. cf. *P. deussenii*, **59**  
*Pteriacea*, 58  
*Pteriidae*, 58  
*Pteropoda*, 266  
*Pteropsinae*, 112  
*Pteropsis*, 85, **112**  
*Pteropsis conradi*, 113  
     *lapidosa*, 12, 36, **112**, 113, Pl. 9, fig. 32  
*pugnax*, *Orthaulax*, 38, **169**  
*pugnax*, *Wagneria*, 169  
*pulaskensis*, *Ostrea*, 76  
*pulchra*, *Noetia*, 51  
*pulchra*, *Trinacria*, 51  
*pulchrus*, *Halonanus*, **51**, 52  
*Pulmonata*, 266  
*punctulifera*, *Agaronia*, 219  
*punctulifera*, *Ancilla staminea*, 219  
*punctulifera*, *Olivula*, 36, **219**  
 "Pupa", 267  
*Pupa Leidyi*?, 267  
*purpurata*, *Olivella*, 217  
*purpurea*, *Mya*, 127  
*Pyramidellidae*, 145  
*Pyrenidae*, 189  
*pyrobola*, *Mazzalina*? *heilpriniana*, 36, **214**  
*Pyrula*, 183, 184, 206  
*Pyrula burdigalensis*, 182  
     *juvenis*, 182  
     *melongena*, 200  
     *mississippiensis*, 184  
     *penita*, 183  
*pyrula*, *Mazzalina*, 213  
*pyruloides*, *Melo*, 229  
*pyrum*, *Sycotypus*, 206  
*pyrum*, *Voluta*, 210  
*quintamaia*, *Phacoides*, **95**, 96  
*quitrinensis*, *Ampullina*, 36, **175**  
*radians*, *Ostrea*, 80  
*radiata*, *Tellina*, 105  
*Ranella*, 161, 188  
*Ranella argus*, 188  
*Rapa supraplicata*, 170  
*rarispinga*, *Voluta*, 227  
*Rathbun*, Mary J., 21  
*raveneli*, *Pecten*, 62



- recurva*, *Natica*, 177  
     *dumblei*, *Ampullina*, 174  
 Red Bluff clay, 5, 18  
 Reeside, John B., Jr., v  
 Regan, John, v  
 Rehder, Harald, v  
*reticularis*, *Oliva*, 216  
*reticulata*, *Arca*, 54  
*reticulata*, *Arca* (*Acar*), 54  
*reticulata*, *Barbatia* (*Acar*), 54  
*reticulata*, *Eucheilodon*, 249  
*reticulata*, *Voluta*, 229  
*Revilla*, 203  
*revillense*, *Cerithium*, 158  
*rhomboidella*, *Anadara*, 55  
*rhomboidella*, *Arca*, 55  
     *parsaba*, *Arca*, 55  
*rhomboides*, *Arca*, 54  
*Rimella*, 164, 165  
*Rimella canalis*, 165  
     *carli*, 165, 166  
     *fissurella*, 165  
     *protracta*, 165  
     sp., 165, Pl. 17, figs. 7, 9  
     *texana*, 164, 165, 166  
         *plana*, 166  
     (*Ectinochilus*?) *carli*, 36, 165, Pl. 17, fig. 8  
*ringens*, *Auricula*, 260  
*ringens*, *Teredo*?, 140  
*Ringicula*, 260  
*Ringicula auriculata*, 260  
     sp., 260  
*Ringiculidae*, 260  
 Rio Conchos, 19, 20  
 Rio Grande embayment, 7, 20  
*Rissoa melanura*, 162  
*robustum*, *Cardium*, 101  
 Roma sand member, 5, 16  
*roscoei*, *Pleurotoma*, 247  
*Rostellaria*, 165  
*Rostellaria fissurella*, 164  
     *houzeaui*, 166  
     *Lamarckii*, 168  
     *palliata*, 166  
     *velata*, 166, 168  
     *vellata*, 168  
     (*Calyptrophorus*) *velata*, 168  
*rostrata*, *Arca*, 43  
*rostrata*, *Bulla* (*Volvula*), 261  
*rotaedens*, *Gemmula*, 241  
*rotunda*, "Martesia", 139  
*rotunda*, *Venericardia*, 93  
*ruffini*, *Anomia*, 74  
*rugatus*, *Volutilithes*, 222  
*rugifera*, *Gyrodes*, 170, 171  
*rugosa*, *Corbula*, 128  
*rugosa*, *Donax*, 110  
  
*Sacella*, 47, 48, 49  
*Sacella atakta*, 48, 49  
     sp. cf. *S. atakta*, 48  
*sagenum*, *Buccinum*, 191  
 Salineño, 15  
 Salt Mountain limestone, 5  
 San Fernando, 20  
 San Luis Potosí, 3  
 San Rafael, 20  
*santa-anai*, *Calorhadia* (*Litorhadia*), 45  
*santa-anai*, *Litorhadia*, 45  
*santander*, *Conus*, 251, 252, 253, 254  
*santander*, *Conus* (*Leptoconus*), 36, 251  
*santander*, *Lacinia*, 36, 204, 205  
*santander*, *Oliva*, 217  
*santander*, *Oliva mississippiensis*, 38, 217  
*santander*, *Pseudoliva*, 36, 195, 196, 197  
*santander*, *Tellina*, 105, 106  
*santanensis*, *Corbula*, 134  
*santanensis*, *Corbula* (*Caryocorbula*), 134  
*santarosana*, *Anadara*, 54, 55  
     *geraetera*, *Anadara*, 55  
*sauridens*, *Conus*, 251, 252, 254  
*sauridens*, *Conus* (*Lithoconus*), 251, 253  
*Saxicava*, 127  
 Say, Stanley, v  
*Saxicavidae*, 138  
*sayana*, *Oliva*, 216  
*sayanus*, *Lyropecten*, 68  
*Scala coronalis*, 146  
     *ferminiana*, 147  
     *staminea*, 147  
     *triginti [a] naria*, 147  
     (*Scalina*) *staminea*, 147  
         *trigintinaria*, 148  
*Scalaria decussata*, 147  
     *staminea*, 147  
     *trigintanaria*, 148  
     *varicosa*, 146  
*Scalina*, 147  
*Scalina escandoni*, 39, 148, 149, Pl. 16, fig. 16  
     sp. cf. *S. staminea*, 147  
     sp. cf. *S. trigintanaria*, 148, Pl. 24, fig. 8  
     *staminea*, 147  
     *trigintanaria*?, 38, 148, Pl. 24, fig. 9  
*scamba*, *Ancilla*, 218  
*scapania*, *Orthoyoldia*, 50  
*scapania*, *Yoldia*, 49  
*Scaphander*, 262  
*Scaphandridae*, 262



- Scaphopoda, 141  
*scapina*, *Orthoyoldia*, 50  
*scapina*, *Yoldia*, 49  
 Schott, Arthur, 271  
 Schuchert, Charles, 4, 271  
*scintillatus corneoides*, *Eburneopecten*, 65  
*Scobinella*, 247, 248, **249**, 250  
*Scobinella coelata*, 249  
     *conradiana*, 248  
     *crassiplicata*, 248  
*Scobinella?* sp., **249**  
*Sconsia*, **181**  
*Sconsia hodgii*, 181  
     *lintea*, 181, 182  
     sp., **182**  
     *zacatensis*, 38, **181**, 182  
*scriptus*, *Murex*, 189  
*sculptus*, *Turbo*, 149  
*Scutella cazonensis*, 20  
*securiformis*, *Callocardia* (*Agriopoma*), 120  
*securiformis*, *Cytherea*, 120  
*securiformis*, *Dione*, 120  
*securiformis*, *Meretrix*, 120  
*sellaeformis*, *Ostrea*, 76, 79, **80**, 82, 135, 207  
     *lisbonensis*, *Ostrea*, 79  
 Sellards, E. H., 4  
 Sellards, E. H. and Baker, C.L., 4, 271  
*sellardsi*, *Anomia*, 73  
*semi-asperum*, *Cardium*, 104  
*Semicassis*, 181  
*semicaudata*, *Jouannetia*, 139  
*Semisinus*, 154  
*semmesi*, *Ostrea*, **78**, 79  
*septemdentata*, *Distortio*, 185  
*septemdentata*, *Distortio* (*Personella*), 184, 185  
*septemdentata*, *Distortrix*, 185  
*septemdentata*, *Personella*, 36, **185**  
*Serpula arenaria*, 154  
     *spirulaea*, 40  
*servata*, *Pleurofusua*, 245  
*servatoides*, *Pleurotoma*, 243  
 Shoal River formation, 5, 20  
*shubutensis*, *Cassis* (*Semicassis*), 180  
*shubutensis*, *Galeodea?*, **180**  
*Sigaretopsis*, **170**  
*Sigaretus*, 177  
*Sigaretus bilix mississippiensis*, 178  
     *mississippiensis*, 178  
*silicata*, *Pleurotoma*, 246, 247  
*siliceus*, *Hemisinus*, 155  
     *mexicanus*, *Hemisinus*, 38, **155**  
*simplex*, *Anomia*, 74  
*singleyi*, *Amaurellina*, 36, **177**  
*singleyi*, *Ceronia*, 114  
*singleyi*, *Mesodesma*, 37, **114**  
 Sinidae, 177  
*sinuatus*, *Crassatellites*, 90  
*Sinum*, **177**  
*Sinum bilix*, 178  
     *declive*, 178  
     *inconstans*, 178  
     *mississippiense*, 18, 38, **178**  
     sp., 10, **178**  
 Siphonodentaliidae, 142  
*Siphonodentalium tetraschistum*, 143  
 Skeneidae, 144  
*smirna*, *Leda*, 43, 44, 48  
*smirna*, *Leda* (*Ledina*), 44  
*smirna*, *Ledina*, **44**  
*smithi*, *Phacoides* (*Parvilucina*), 96  
*smithii*, *Venericardia*, 100  
*smithvillensis*, *Conus*, 251  
*smithvillensis*, *Conus* (*Leptoconus*), 36, **251**  
*smithvillensis*, *Conus* (*Lithoconus*), 251  
*smithvillensis*, *Corbula*, 128, 129, 130  
*smithvillensis*, *Corbula aldrichi*, 128  
*smithvillensis*, *Corbula* (*Varicorbula*), **128**  
*smithvillensis*, *Ostrea*, 79  
*sobrina*, *Macrocallista*, 115  
*sobrina*, *Macrocallista* (*Chionella*), 115  
*Solariaxis*, 152  
*Solarium*, 150  
*Solarium acutum*, 153  
     *alveatum*, 151  
     *bilineatum*, 151  
     *cognata*, 151  
     *granulatum*, 151  
     *millegranum*, 152  
*Solen*, 111  
*Solen ambiguus*, 111  
     *lisbonensis*, 111  
     *marginatus*, 111  
     *obliquus*, 111  
     *plagiaulax*, 111  
     (*Plectosolen*) *lisbonensis*, 111  
         *abruptus*, 111  
*Solena*, **110**, 111  
*Solena lisbonensis*, 111  
     *abruptus*, 111  
     *plagiaulax*, 111  
     (*Eosolen*) *lisbonensis*, **111**  
         *abruptus?*, **111**  
 Solenacea, 110  
 Solenidae, 110  
*solenoides*, *Orthoyoldia*, 50  
*solida*, *Clementia*, 122  
 South Texas, 7, 10, 12, 15  
*sowerbyana*, *Leda*, 49



- Sparta sand, 13  
*spenceri*, Chione, 124  
*spenceri*, Chione (Chione), 124  
*Sphaerella*, **97**  
*Sphaerella anteproduca* [t] a, 98  
     *anteproduca*, 13  
     *inflata*, 98  
     *subvexa*, 97  
     *turgidula*, 98  
*Sphaerella?* *anteproduca*, 98  
*spheniopsis*, Nucula, 37, **42**  
*spica*, Hemisinus, 155  
*spiniger*, Busycon, **206**  
*spiniger*, Fulgur, 206  
*spiniger*, Fusus, 206  
*spinosa*, Volutilithes, 222  
*spinosus*, Conus, 224  
*spirata*, Ampullina, 177  
*spirifer*, Celliforma, 269  
*spirulaea*, Serpula, 40  
*Spisula funerata*, 112  
     sp., 21  
     (*Hemimactra*) *craspedota*, 112  
     *densa*, 112  
 Spondylidae, 70  
*Spondylus*, 70  
*Spondylus plicatus*, 70  
*squamosa*, Arca, 54  
*staminea*, Ancillaria, 219  
*staminea*, Glycymeris, 51  
*staminea*, Scala, 147  
*staminea*, Scala (Scalina), 147  
*staminea*, Scalaria, 147  
*staminea*, Scalina, 147  
*staminea punctulifera*, Ancilla, 219  
*stantoni*, Surculoma, 242  
 Starr County, 15, 16  
 Staub, Walther, 271  
*Stellaxis*, **151**  
*Stenoglossa*, 187  
 Stenzel, H. B., 12, 271  
 Stephenson, Lloyd W., v, 3, 271  
 Stewart, Ralph, v  
*stewarti*, Lithophysema, 37, **263**  
 Stone City beds, 13  
 Stratigraphic Notes, 4  
*Streptoneura*, 144  
*striata*, Cassidaria, 181  
*striata*, Tuba antiquata, 150  
*strigilatum*, Buccinum, 257  
*Strigilla*, **108**  
*Strigilla* sp., **108**  
*Strigilla?* sp., **108**  
*Strioterebrum*, **255**, 256  
 Strombacea, 163  
 Strombidae, 164  
*Strombina*, 237  
*Strombus canalis*, 165  
     *subaequalis*, Pleurotoma, 242  
     *subalveatum*, Triton, 186  
     *subangulata*, Caricella, 229  
     *subcancellata*, Cypraedia, 179  
     *subcoarctatus*, Cadulus, 143  
     *subcoarctuata*, Ditrupa, 142, 143  
     *subcoarctuatus*, Cadulus, 142  
     *subglobosa*, Ancilla, 199  
     *subglobosa*, Ancillaria, 199  
     *subglobosa*, Ancillopsis, 37, **199**  
     *subglobosa*, Bullia altilis, 199  
     *subgrundifera*, Turritella, 39, **153**  
     *subrigaultiana*, Divaricella, 97  
     *subtrigonalis*, Corbula, 137  
 Subula, 256  
     *subulatum*, Buccinum, 255  
     *subvaricata*, Actaeonina, 259  
     *subvaricatus*, Actaeon, 259  
     *subvexa*, Anodontia?, **94**, 95  
     *subvexa*, Cyclas, 95  
     *subvexa*, Loripes, 95  
     *subvexa*, Lucina, 94, 95  
     *subvexa*, Lucina (Loripes), 95  
     *subvexa*, Sphaerella, 97  
     *sulcata*, Corbula, 127  
     *sulcata*, Modiola, 56  
     *sulcatus*, Turbo, 149  
*Sulcobuccinum*, (*Buccinorbis*) *carinata*, 197  
     *linosa*, 198  
     *vetusta*, 196  
*Sulcocypraea*, 179  
*Sulcocypraea kennedyi*, 179  
*supramirifica*, Pleurotoma (*Pleuroliria*), 245  
*supraplicata*, Rapa, 170  
*Surcula*, 231, 233, 247  
*Surcula gabbi*, 234  
     *gabbii*, 234  
     *moorei*, 235  
     *nodifera*, 231  
     *nodocarinata*, 238  
     *texana*, 244  
*Surculites*, 204, **231**  
*Surculites annosus*, 231  
     *cabezai*, 36, **232**, 233, Pl. 15, figs. ?20, ?21;  
         pl. 16, figs. 1, 4, 7  
     *cortezi*, 14, 36, **232**, 233, Pl. 15, figs. 19, 22  
     *engonata*, 232  
         *exoleta*, 233  
     *errans*, 231



- Surculoma*, **242**, 243  
     *dumblei*, 242  
*Surculoma penrosei*, 212, 242, 243  
     *stantoni*, 242  
     sp., **243**, Pl. 25, fig. 13  
 Suwanee limestone, 5, 17, 19  
*Sycostoma*, 194  
*Sycotypus*, **206**  
*Sycotypus aepynotus*, 206  
     *canaliculatus*, 206  
     *pyrum*, 206  
     sp., 20, **206**  
*Sycum*, 194  
*symmetrica*, *Volutalithes*, 226  
*symmetrica*, *Volutalithes*, 226  
*symmetrica*, *Volutospina*, 37, **226**  
 Systematic Descriptions, 40  
  
*tabulata*, *Pleurotoma*, 242  
*Taenioglossa*, 153  
*Taitii*, *Fusus*, 202  
 Tallahatta formation, 5, 11  
 Tamaulipas, 1, 3, 4, 10  
 Tampa limestone, 5  
*tampaënsis*, *Nerita*, 38, **145**  
 Tampico embayment, 20  
 Tanlajás formation, 7  
*tantula*, *Terebra*, 255, 256, 257  
*tantula*, *Terebra* (*Strioterebrum*), 38, **255**  
*Tapes*, 121  
*taphrium*, *Cerastoderma* (*Dinocardium*), 102  
 Tatum, J. L., 3, 4, 271, 272  
 Tectibranchia, 258  
*tectum*, *Buccinum*, 186  
*Teinostoma*, **144**  
*Teinostoma politum*, 144  
*Teinostoma* sp., **144**  
 Teleodesmacea, 89  
*tellea*, *Pleurotoma albida*, 246  
*Tellina*, **105**, 107  
*Tellina carnaria*, 108  
     *cherokeensis*, 106  
     *cuspidata*, 88  
     *ferröensis*, 109  
     *fervensis*, 109  
     *gari*, 109  
     *linifera*, 107  
     *meyeri*, 107  
     *mooreana*, 12, 36, **106**  
     *papyria*, 106  
         *mooreana*, 106  
     *pectinata*, 95  
     *radiata*, 105  
     *santander*, 36, **105**, Pl. 4, fig. 12  
         sp. A., 105  
         *virgata*, 107  
         (*Tellinella*?) sp., **107**, Pl. 7, figs. 11, 19  
 Tellinacea, 105  
*Tellinella*, **106**, 107  
 Tellinidae, 105  
*tellinoides*, *Astarte*, 89  
*tellinoides*, *Lirodiscus*, 90  
*tenagos*, *Pleuroliria*, 39, **246**  
*tenagos*, *Polystira* (*Pleuroliria*), **246**  
*tenuirostris*, *Protosurcula*, 234  
*tenuisculpta*, *Lucina*, 96  
*Terebra*, **255**  
*Terebra basteroti*, 255  
     *divisurum*, 255, 257  
     *gatunensis*, 257  
     *houstonia*, 257, 258  
     *inaequalis*, 257  
     *mirula*, 256, 257  
     *plicatula*, 258  
     *plicifera*, 162, 214  
     *polygyra*, 257  
     *protexta*, 256  
     sp. cf. *T. texagyra*, 14  
     *tantula*, 255, 256, 257  
     *texagyra*, 256, 257  
     (*Strioterebrum*) sp., **257**  
         sp. cf. *T. (S.) texagyra*, 36, **256**, 257,  
             Pl. 27, figs. 9, 25  
         *tantula*, 38, **255**, Pl. 27, figs. ?1, ?14  
         *texagyra*, 256, 257  
     (*Terebrella*) *mirula*, 256  
*Terebrella*, **256**  
 Terebridae, 255  
*terebriformis*, *Pleurotoma*, 243  
*Terebrifusus*, 191  
 Teredinidae, 139  
*Teredo*, **139**, 140  
*Teredo navalis*, 139  
     *polythalamia*, 140  
     sp., 140  
*Teredo? incrassata*, 141  
     *ringens*, 34, **140**  
*Teredo* (*Kuphus*) *incrassata*, 140  
     aff. *polythalamia*, 140  
*tesselata*, *Mitra*, 220  
*tetraschistum*, *Siphonodentalium*, 143  
*tetrica*, *Cardita*, 93  
*tetrica*, *Venericardia*, 93, 94  
*texacola*, *Callocardia*, 117  
*texacola*, *Meretrix*, 117, 118  
     *tornadonis*, *Cytherea*, 117  
     *tornadonis*, *Meretrix*, 117  
*texagyra*, *Terebra*, 256, 257



- texagyra*, *Terebra* (*Strioterebrum*), 256, 257  
*texana*, *Asthenotoma*, 244  
*texana*, *Corbula*, 127, 128, 157  
*texana*, *Corbula* (*Aloidis*), 127  
*texana*, *Corbula* (*Varicorbula*), **127**  
*texana*, *Crassatella*, 91  
*texana*, *Gegania*, 150  
*texana*, *Goniobasis*?, 157  
*texana*, *Lutetia*, **99**, 126  
*texana*, *Phos*, 192  
*texana*, *Pleurotoma*, 244  
*texana*, *Rimella*, **164**, 165, 166  
     *plana*, *Rimella*, 166  
*texana*, *Surcula*, 244  
*texana*, *Texania*, 156  
*texana*, *Texmelanatria*, 156, 157  
*texana*, *Tibiella*, 266  
*texana*, *Trypanotopsis*, 36, 243, **244**  
*texana*, *Tuba antiquata*, 150  
*texana*, *Turris*, 243, 244  
*texana*, *Volutocorbis*, 223, 228  
*Texania*, 156  
*Texania texana*, 156  
*texanum*, *Buccitriton*, 192  
*texanum*, *Cerithium*, 156, 157  
*texanus*, *Brachidontes*, 56  
*texanus*, *Buccitriton*, 36, **192**  
*texanus*, *Crassatellites*, **91**  
*texanus*, *Ectinochilus*, 164  
*texanus*, *Ectinochilus* (*Macilentos*), 164  
*texanus*, *Phos*, 191, 192  
Texas, 3, 4, 5, 6, 7, 9, 10, 11, 12  
*texasiana*, *Callocardia* (*Agriopoma*), 119  
*texasiana*, *Cytherea*, 116  
*Texmelanatria*, **156**  
*Texmelanatria angeloi*, 36, **157**, Pl. 17, fig. 20  
     sp. cf. *T. texana*, **156**, Pl. 17, fig. 19  
     *texana*, 156, 157  
*Textiscala*, 147  
*thalloides*, *Dentalium*, 142  
Thayer, Warren N., 272  
Thecosomata, 266  
*thetidis*, *Chlamys*, 66  
*thetidis*, *Pecten*, 67  
*thetidis*, *Pecten* (*Aequipecten*), 67  
*thirsae*, *Gryphaea*, 76  
*thirsae*, *Ostrea*, 75, **76**, 77, 79  
*thomasiae*, *Cerithium*, 161  
*Thracia*, **86**, 87, 88  
*Thracia conradi*, 86  
     *corbuloidea*, 86  
*Thracia*? sp., **87**, Pl. 7, figs. 7, 8  
*Thracia* (*Cyathodonta*) sp. cf. *T. (C.) vicksburgiana*, **87**  
     *vicksburgiana*, 87, 88  
*Thraciidae*, 86  
*Tibiella*, **266**  
     *marshi*, 266  
     *texana*, 266  
*Tibiella*? sp. ind., **266**  
*tobar*, *Orthosurcula longipera*, 233  
*tornadonis*, *Callocardia*, 118  
*tornadonis*, *Callocardia* (*Agriopoma*), **117**  
*tornadonis*, *Cytherea*, 117  
*tornadonis*, *Cytherea texacola*, 117  
*tornadonis*, *Meretrix texacola*, 117  
*Tornatellaea*, **259**  
*Tornatellaea bella*, 259  
     *cerralvensis*, 35, **259**, Pl. 12, fig. 3  
*Tornatina*, 260, 261  
*Tornatina angelinae*, 261  
*tortilis*, *Conus*, 253  
*tortilus*, *Conus*, 252, 253, 254  
*tortilus*, *Conus* (*Leptoconus*), 37, **253**  
*Toxoglossa*, 229  
*trabeatoides*, *Levifusus*, 230, 231  
*trabeatoides*, *Michela*, 36, **231**  
*trabeatus*, *Levifusus*, 230, 231  
*Trachycardium*, **103**, 104  
*Trachycardium* sp., **103**, Pl. 11, fig. 2  
*trapaquarus*, *Crassatellites*, 91  
*tribulus*, *Murex*, 187  
*trigintanaria*, *Scalaria*, 148  
*trigintanaria*, *Scalina*, 148  
*trigintanaria*?, *Scalina*, **148**  
*triginti [a] naria*, *Scala*, 147  
*trigintinaria*, *Scala* (*Scalina*), 148  
*trigonalis*, *Ostrea*, 82, **83**  
*Trigonarca declivis*, 52  
*trigoniata*, *Meretrix*, 116  
     *bastropensis*, *Meretrix*, 116, 117  
*Trigoniocardia*, **103**, 104  
*Trigoniocardia alicula*, 104  
     sp., 19, **104**  
*Trigonostoma*, **230**  
*trigonostoma*, *Delphinula*, 230  
*Trinacria declivis*, 52  
     *pulchra*, 51  
     sp., 10  
*trinitaria*, *Metis*, 108  
*trinodiferus*, *Calyptrophorus*, 167, 168  
*Triptera*, 266  
*Tritiaria*, **190**, 192  
*Tritiaria cerralvensis*, 35, **190**, Pl. 16, figs. 5, 11  
*Tritiaria*? *zacatensis*, 37, **191**, Pl. 22, fig. 13  
*tritiaria*, *Priscoficus*, 182  
*tritiaria*, *Priscoficus* (*Fulguroficus*), **182**  
*Triton subalveatum*, 186  
*Tritonopsis*, **186**  
*trivolvus*, *Perissolax*, 183



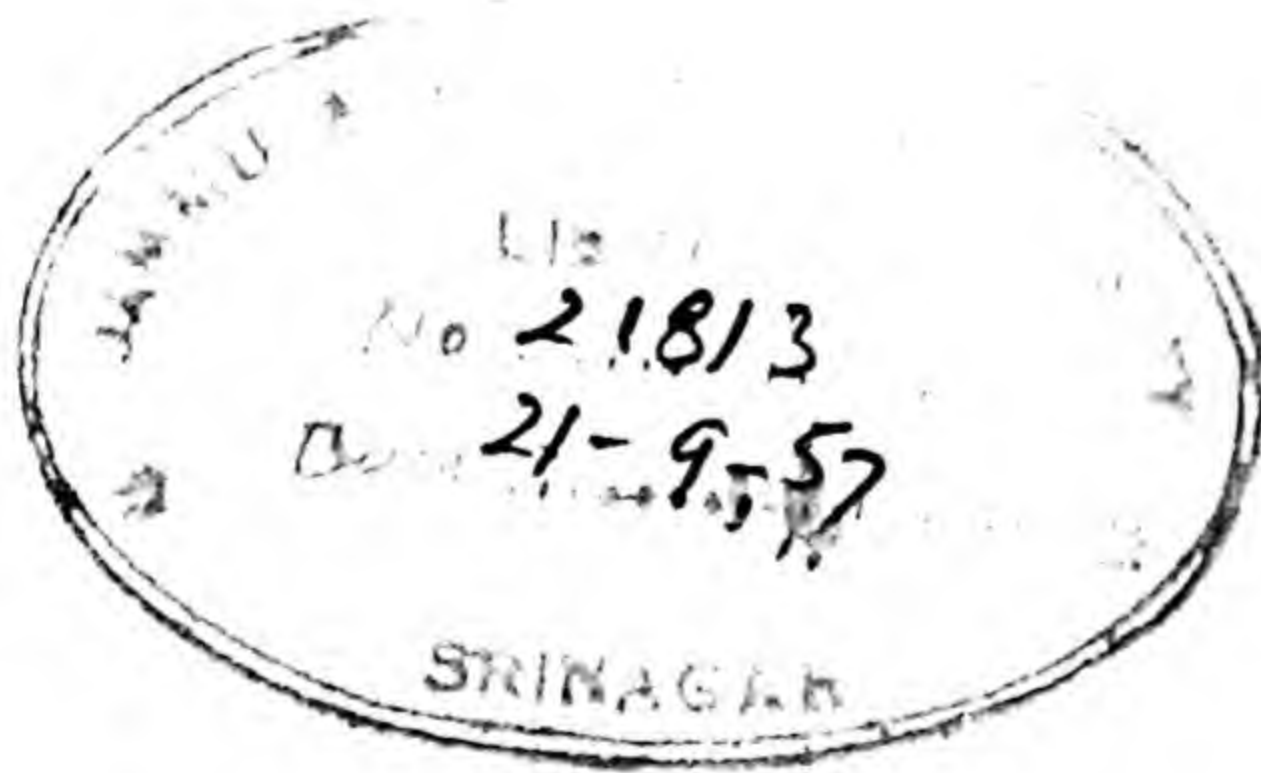
- Trochacea, 144  
*Trochopora bouei*, 71  
*Trochus conchyliophorus*, 163  
     *perspectivus*, 150  
 Trowbridge, A. C., 3, 272  
*trumani*, *Calorhadia*, 46  
*Trypanotoma*, 243  
*Trypanotopsis*, **243**  
*Trypanotopsis texana*, 36, 243, **244**, Pl. 27, fig. 15  
*Tuba*, 149  
*Tuba alternata*, 149  
     *antiquata*, 150  
     *striata*, 150  
     *texana*, 150  
*tuberculata*, *Hemisinus*, 154  
*tuberculata*, *Melania*, 154  
*tubifer*, *Murex*, 188  
*Tubulostium*, **40**  
*Tubulostium cortezi*, 11, 36, **40**  
*tulipa*, *Murex*, 215  
*tumens*, *Venus*, 122  
*tumidulus*, *Crassatellites*, 91  
*tuomeyi*, *Athleta*, 227, 228  
*tuomeyi*, *Athleta petrosa*, 228  
*tuomeyi*, *Cerastoderma*, 100, 101  
*tuomeyi*, *Plejona*, 228  
*tuomeyi*, *Pleurotoma*, 235  
*tuomeyi*, *Voluta*, 228  
*tuomeyi*, *Volutilithes*, 228  
*tuomeyi*, *Volutilithes petrosus*, 228  
*tuomeyi*, *Volutilithes (Athleta)*, 228  
*tuomeyi*, *Volutospina*, 196, 227, 228  
*tuomeyi*, *Volutospina (Eoathleta)*, **228**  
*Turbinella piruloides [pyruloides]*, 228  
     sp., 210  
     *wilsoni*, 210, 211  
*Turbo sculptus*, 149  
*Turbo sulcatus*, 149  
*Turbonilla*, **145**  
*Turbonilla bidentata*, 146  
     *bidentata?*, **146**, Pl. 27, fig. 16  
     *costulata*, 145  
     (*Pyrgolamprus*) *bidentata*, 146  
*turgida*, *Diplodonta*, 98  
*turgida*, *Loripes?*, 98  
*turgidula*, *Sphaerella*, 98  
*Turricula gabbi*, 234  
 Turridae, 230  
*Turris moorei*, 235  
     *nodocarinata*, 237, 239  
     *texana*, 243, 244  
*Turritella*, **153**  
*Turritella arenicola*, 16, 47, 138  
     *cortezi*, 12, 36, 46  
     *humerosa*, 7  
     *nasuta*, 13, 36  
     *sanjuanensis*, 7, 34  
     *subgrundifera*, 20, 39, **153**  
 Turritellidae, 153  
*turritum*, *Dentalium*, 143  
 Tuscahoma sand, 5, 8, 9  
 Tuxpan formation, 20  
*Typhis*, **188**  
*Typhis curvirostratus*, 38, **189**, Pl. 14, figs. 1, 2  
  
*ulrichi*, *Nautilus*, 268  
*umbilicata*, *Bulla*, 266  
*umbonata*, *Lutetia*, 99  
*undulata*, *Cyathodonta*, 87  
 U. S. Geological Survey Station Numbers, 21  
 Upper marine sandstone, 18  
 Upper Oligocene, 19  
 Urocoptidae, 266  
*Urocoptis (Urocoptis)*, 267  
*Urosyca*, 182  
*Urosyca caudata*, 182  
*Uzita*, **193**  
*Uzita wallonensis*, 39, **194**  
  
*varicifer*, "*Pseudotaphrus*", 162  
*Varicorbula*, **127**, 136  
*varicosa*, *Scalaria*, 146  
*variegata*, *Ficus*, 183  
*vatheliti*, *Clementia*, 122  
 Vaughan, Thomas Wayland, 3, 272  
*vaughani*, *Anadara*, 55  
*vaughani*, *Arca*, 55  
*vaughani*, *Cimomia*, 268  
*vaughani*, *Enclimatoceras*, 268  
*vaughani*, *Hercoglossa*, 268  
*vaughani insularis*, *Ostrea*, 84, 85  
*velata*, *Rostellaria*, 166, 168  
*velata*, *Rostellaria (Calyptrophorus)*, 168  
*velatus*, *Calyptrophorus*, 36, 37, 167, **168**  
*velatus (Rostellaria)*, *Calyptrophorus*, 168  
*vellata*, *Rostellaria*, 168  
 Veneracea, 114  
*Venericardia*, **92**  
*Venericardia carsonensis*, 94  
     *densata*, 13  
     *diga*, 8, 9, 77  
     *diga zone*, 228  
     *diversidentata*, 93  
     *imbricata*, 92  
     *jacksonensis*, 93  
     *potapacoensis*, 8  
     *praecisa*, 94  
     *rotunda*, group of, **93**, Pl. 7, figs. 17, 18



- smithii*, 100  
 sp. cf. *V. carsonensis*, 18, 38, **94**  
 sp. cf. *V. diversidentata*, **93**  
*tetrica*, 93, 94  
*vicksburgensis*, 94  
 (*Venericor*) *cacamai*, 36  
     *densata*, 36  
     *diga*, 34  
     *planicosta*, 93  
 Veneridae, 114  
*Venerupes*, 121  
*ventricosum*, *Cardium*, 101  
*Venus*, 122  
*Venus, cancellata*, 124  
     *dione*, 123  
     *dysera*, 124  
     *edentula*, 94  
     *gallina*, 125, 126  
     *gigantea*, 114  
     *imbricata*, 92  
     *inoceriformis*, 122  
     *lupina*, 97  
     *mississippiensis*, 125  
     *nimbosa*, 114  
     *papyracea*, 121  
     *tumens*, 122  
 Vermes, 40  
 Vermetidae, 154  
 Ver Wiebe, Walter A., 272  
*vetusta*, *Acanthina* (*Gastrium*), 196  
*vetusta*, *Monoceros*, 196  
*vetusta*, *Pseudoliva*, 36, 37, 195, **196**  
     *linosa*, *Pseudoliva*, 198  
     *perspectiva*, *Pseudoliva*, 197  
*vetusta*, *Pseudoliva* (*Buccinorbis*), 196  
*vetusta*, *Sulcobuccinum* (*Buccinorbis*), 196  
*vetustus*, *Monoceros*, 196  
*vexillum*, *Pinna*, 60  
 Vicksburg fauna, 19  
 Vicksburg group, 5, 17, 18  
*vicksburgensis*, *Nucula*, 42  
*vicksburgensis*, *Ostrea*, 39, 83, **84**  
*vicksburgensis*, *Pleurofusua*, 38, **245**  
*vicksburgensis*, *Pleurotoma*, 245  
*vicksburgensis*, *Venericardia*, 94  
*vicksburgiana*, *Thracia* (*Cyathodonta*), 87, 88  
*vieja*, *Cuspidaria*, 88, 89  
*vieja*, *Cuspidaria* (*Cardiomya*), **88**  
*vinctum*, *Cerithium*, 158  
*virgata*, *Tellina*, 107  
*virginica*, *Ostrea*, 84  
*vitellus*, *Nerita*, 171  
*Voluta*, 250  
*Voluta affinis*, 227  
     *ampla*, 218  
     *coronata*, 227  
     *pyrum*, 210  
     *rarispina*, 227  
     *reticulata*, 229  
     *tuomeyi*, 228  
 Volutacea, 207, 216  
*volutata*, *Volvutella*, 262  
 Volutidae, 210, 222  
*Volutilithes*, 222, 224, 227  
*Volutilithes abyssicola*, 222  
     *digitalina*, 222  
     *lima*, 222  
     *limopsis*, 222, 223, Pl. 20, fig. 1  
     *petrosa*, 222  
     *petrosus tuomeyi*, 228  
     *precursor*, 223  
     *rugatus*, 222  
     *spinosa*, 222  
     *symmetrica*, 226  
     *tuomeyi*, 228  
     *Wheelockensis*, 223  
     (*Athleta*) *tuomeyi*, 228  
     (*Volutocorbis*) *limopsis*, 222  
*Volutocorbis*, **222**, 224, 228  
*Volutocorbis lapparoides*, 168  
     *limopsis*, 7, 222, 223, 224, Pl. 20, fig. 1  
     *lisbonensis*, 224  
         *crockettensis*, 223  
     *olssoni*, 223  
     sp., **222**  
     sp. cf. *V. olssoni*, **223**, pl. 22, fig. 12  
     *texana*, 223, 228, Pl. 16, figs. 2, 3  
     *wheelockensis*, 223, 224, Pl. 23, fig. 2  
*Volutocorbis? haleanus*, 224, Pl. 22, figs. 1, 5  
     sp. cf. *V.? wheelockensis*, 12, 36, **223**, Pl. 22, fig. 11  
*Volutospina*, **224**  
*Volutospina clayi*, 13, 36, **224**, 225, Pl. 22, fig. ?14  
     *corvocada*, 6  
     *impressa*, 225, Pl. 23, figs. 1, 3  
     *indenta*, 225, Pl. 23, figs. 8, 9  
     *lapparoides*, 13, 14, 36, **225**, 226, Pl. 22, figs. 2-4, 7, 9, 10  
     *petrosa*, 224, 225, 226, Pl. 16, fig. 18  
     *symmetrica*, 16, 37, **226**, Pl. 22, fig. 8; pl. 23, figs. 7, 10  
     *tuomeyi*, **196**, 227, 228  
     (*Eoathleta*) *corvocada*, 35, **227**, Pl. 12, figs. 2, 9; pl. 27, fig. 10  
     *tuomeyi*, 8, 35, **228**, Pl. 12, figs. 10-12; pl. 22, fig. 6  
 Volvula, 261



- Volvulella*, **261**  
*Volvulella conradiana*, 262  
     *garzai*, 37, **261**, 262, Pl. 27, fig. 24  
     *volutata*, 262, Pl. 27, figs. 28, 29  
*vomer*, *Ostrea*, 76  
*wredenburgi*, *Cyclomolops*, 166  
*vulgaris*, *Gari*, 109  
  
*Wagneria*, 168, 169  
*Wagneria pugnax*, 169  
*wahltubbeana*, *Chlamys*, 65  
*wailesiana*, *Corbula*, 131, 132  
*waltonensis*, *Alectrion*, 194  
*waltonensis*, *Uzita*, 39, 194  
*waltonia*, *Anadara*, 55  
Webb County, Texas, 10, 12  
*webbi*, *Cerithium*, 175  
Weches greensand member, 11  
*Wetherellii*, *Acteon*, 260, 261  
*wheelockensis*, *Athleta*, 223  
*wheelockensis*, *Volutilithes*, 223  
*wheelockensis*, *Volutocorbis*, 223, 224  
Whitsett member, 5  
Wilcox group, 3, 5, 7  
Wilcox, upper, 9  
Wills Point clay, 5  
  
*wilsoni*, *Mazza*, 210  
*wilsoni*, *Turbinella*, 210, 211  
*wilsoni*, *Xancus*, 37, 38, **210**, 211  
Winona sand member, 11  
  
Xancidae, 207, 210  
*Xancus*, **210**, 211  
*Xancus peruvianus*, 211  
*Xancus wilsoni*, 37, 38, **210**, 211  
*Xenophora*, **163**  
*Xenophora laevigata*, 163  
*Xenophora* sp., 36, 163, **164**, Pl. 17, figs. 14, 15  
Xenophoridae, 163  
  
Yazoo clay, 5  
Yegua formation, 5, 12, 14  
*Yoldia*, 43, 50  
*Yoldia eborea*, 44  
     *psammotaea*, 50  
     *scapania*, 49  
  
*zacatensis*, *Hesperiturris*, 37, **239**  
*zacatensis*, *Sconsia*, 38, **181**, 182  
*zacatensis*, *Tritiaria?*, 37, **191**  
Zapata County, 12, 15  
*ziczac*, *Ostrea*, 62



ALLAMA IQBAL LIBRARY



21813



